THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW

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THE POPULARITY OF ELECTRICITY.

THERE has been no waning of the popularity of the Manchester Exhibition; indeed, on Saturday last, as the official figures show, all previous records were broken, the attendance totalling 28,000 for the day, and the gate money exceeding that of any other day during the run. Not only was Saturday a full day, however, for we understand that on the preceding Thursday the hall had to be closed at times, and some visitors who had come many miles by rail expressly to visit the Exhibition, had to content themselves with the lesser and outside charms of salubrious Manchester, having either failed absolutely to secure admission, or having heard second-hand in the contiguous park that their chances of seeing things to advantage were very remote, owing to the crush. This is, of course, a disappointing experience, and it may have been due to the railway companies not appreciating in the earlier stages that the Exhibition was an event worthy of their excursion notice, but it is an additional testimony, if one were needed, to the immense and continued popularity of the show. No doubt, this has been unceasing during this week, and it will be surprising if Friday and Saturday, the last two days of the Fair, do not bring larger crowds than ever. By some the interest taken by the public is described as quite phenomenal. Everything electrical possesses a luring attractiveness and glamour which excite a healthy curiosity on the part of the people, and this is one of the things which at the present time seems to us to hold such promise for the future of electrical affairs, for a curiosity properly aroused and healthily fed and fostered, must promote an insatiable desire to possess as far as lies within one's power, the newer and more efficient facilities that we, as electrical men, place before the individual units in the community.

Very many are the texts that the electrical journalist has had put before him during the past month as a basis for interesting and useful disquisitions. Some of them will keep, but at the moment one must be impressed with the present-day popularity of electricity, and appreciating the fact, we ought to take the utmost advantage of it with the object of benefiting the electrical trade of this country.

Who has not heard the shrieks of laughter from women, and others who are not nominally of that sex, as the bones of themselves and their lovers have been revealed in all their nakedness by the instrumentality of the X-rays? Or felt the tremors of the applause which greets the popular lecturer on wireless telegraphy as he rings by the uncanniness of invisibility a bell at the other end of the room? Or observed the eager interest of an audience as it watches the pretty effects of Tesla high-frequency apparatus, or noticed the multifarious other expressions of the interested listeners to a popular exposition of the achievements of electrical science? All of this is something to the good, making electricity more and more popular with the common people whose changing customs will bring grist to the electrical engineer's and manufacturer's mill. There is a need for something that may, perhaps, pardonably be described as the cultivation of the Electrical Habit. The popular lecturer may say many things that the technical man would be obliged to criticise were he seated

among the audience, but if he succeed in arousing the electrical interest of his hearers in such a way that it will be maintained, he has been doing a part, however small, and however much he may be accused of playing to the gallery, in helping forward electrical progress. The daily Press sometimes appreciates the existence of the thirst of the public for interesting electrical notes, and it serves up a vague mixture of a dish occasionally, but unfortunately in such a way that the technical journalist comes down upon the writer, because of the misleading nature of the information he imparts. We verily believe that if all the newspaper editors of London could have been taken *en masse* to Manchester, or through the Olympian Electrical Exhibition of 1905, there would be far greater, and far more efficient, attention given to electrical achievements, always supposing that the said editors or their newspapers have not gas predilections. (See the *Daily Chronicle* page of Tuesday this week.)

The Manchester Exhibition is about to close its doors, it having done its work among the people of the district to which it was intended more particularly to appeal. It has undoubtedly stirred up the public interest in a remarkable manner, and has sown seed which must bear fruit; it will keep the people thinking and talking for many a day. But the effect is naturally, so far as the people are concerned, almost solely confined to that district at the moment, however much it may spread therefrom by correspondence one with another, and by conversation when friends meet. We are not considering here the benefit brought to electrical engineers themselves through seeing one another, and one another's work, at the Exhibition, and discussing matters together. To the public of Manchester and the surrounding district, the Exhibition has undoubtedly been absorbingly interesting, and from that fact, as we have said, benefit must come to the trade.

Application of Electricity at the Hartlepools.

We notice in the columns of our contemporary, the *Shipping World*, for October 21st, an interesting account of the way in which the development of the North-Eastern Railway Hartlepool Docks has been pushed forward in recent years. In 1865 this railway company acquired the docks on the east and west side of the harbour, and by their initiative and enterprise they have developed this port, not only as the principal outlet for coal export in the South of Durham Coalfield, but also as a centre for the import of timber. The origin of this recent industry is the necessity for pit props in the coal mines, but it has been largely added to for miscellaneous purposes as the facilities of the harbour for this class of trade have become more fully recognised. The coal industry is likely to receive considerable impetus in the near future, as several new collieries have been recently opened out in the district, and others will be commenced during the next few years. The present position of the mineral shipment may be illustrated by the fact that in 1900 the total exports and imports amounted to 2,512,359 tons; in 1902 they rose to 2,918,507 tons; in 1903 the figure was 3,108,311 tons, and since that date, owing to facilities for rapid loading and bunkering at the docks and in the tidal harbour, together with recently erected deep-water coal staithes, the business has largely increased.

Electricity has played a prominent part in this development. Pit props, zinc and other ores, and timber are discharged directly and quickly from ship to truck by a complete equipment of electric cranes of the jib type running on rails parallel to the water's edge. Both in the Union and the Central Dock special facilities for unloading by electricity are provided, and the practical effect of this equipment has been to revolutionise work at the docks and to create an enviable reputation for the quick dispatch given to vessels. The presence of such an extended system of electric power supply in the vicinity of Hartlepool, and throughout South Durham and North Yorkshire, as that provided by the operations of the Cleveland and Durham Electric Power, Ltd., renders this area a particularly favourable one for the establishment of new industries, aided by the advantages of cheap sites and easy transit; and this will, no doubt, have a beneficial effect in improving the trade of the Hartlepools in future.

Copper.

The price of this metal is well maintained, in spite of the extraordinary position of the visible supplies. These totalled, as per Messrs. Merton's reports, 50,277 tons at the end of September, and 52,245 tons at October 15th! Of this figure, 35,692 tons are in British ports or towns, and 11,300 tons afloat. Deliveries continue to be fairly maintained, though not in proportion to the supplies.

Commenting on the situation, the *Financier* thinks the market is waiting on the Presidential Election in America, and does not anticipate lowered prices, consequent on overproduction. (The writer might have omitted from an otherwise well-considered article the ancient formula "electrical enterprise is even now in its infancy"). The continued firmness of price is certainly an argument against the overproduction theory, and it points to a restrained demand, which may come on suddenly.

Provisional Orders.

A circular, dated October 26th, has just been issued by the Board of Trade with reference to the large number of cases in which, in recent years, provisional orders obtained by local authorities for electric lighting have had to be revoked owing to their having lain in abeyance. The Board deprecates the application for an order unless there be a serious intention on the part of the promoters to exercise the powers conferred upon them, and states that in future, before granting an order, it will require evidence that a scheme has been definitely considered by the promoters, and that the application is made in good faith, with the view of putting the scheme into operation.

The flagrant abuse of their privileges by local authorities in this connection is too notorious to need emphasis at this time; numerous orders have been obtained purely for the purpose of blocking the way, either in the interests of local gas undertakings, or out of blind unreasoning hostility to private enterprise. The Board of Trade has powers to revoke the orders in all such cases, but many of them have been allowed to linger on for periods of 8 or 10 years, or even longer, before being cancelled. According to Garcke's Manual, out of 1,048 orders made by the Board of Trade and confirmed by Parliament, some 227 have been revoked or repealed; since 1905 about 71 orders have been made, and deducting these also from the total, it appears that about 750 orders had been in force for two years at the end of 1907. But even after allowing for cases where several orders are worked by one undertaking, there are not more than 500 electric lighting orders of which the powers have been exercised, so that some 250 orders are more than two years old, and are still lying dormant.

Granted that in many of these cases there is not—nor ever was—any reasonable prospect of a supply of electricity being given either by a company or by the local authority, the obvious fact remains that in a great number of instances electric lighting orders are in force which have become moribund, and ought to be withdrawn, lest they should hinder the introduction of a supply by the agency of private enterprise.

It may be argued that not seldom a district has ultimately benefited by the delay incurred, having eventually received a cheap supply from a large undertaking in its vicinity instead of saddling itself with a small inefficient and relatively costly installation of its own, and this is certainly true in some cases; but in general, as the Board of Trade evidently realises, the district suffers injury from the suppression of these powers, and we are very glad to see that in future orders sought for the purpose of blocking progress or safeguarding the vested interests of local cliques will not be granted. We trust, too, that the Board will scrutinise the list of existing unused orders and revoke all that are not likely to be exercised at an early date.

The Free Labour Congress.

In the midst of Trade Union controversies and strikes it is refreshing to consider the utterances of those who attend the Free Labour Congress. On Monday last this body, to whose very laudable objects we referred in our issue of October 9th, passed a resolution to the effect that the present crisis in the labour market was largely due to Trade Union monopoly. Mr. Joseph Penrose, in the course of his Presidential address, said: "The difference between a Trade Union striker and the much-abused and maligned free labourer is that one leaves his job, and then makes a senseless attempt to injure and wreck the trade and industry of the country, seeking by destructive methods to construct a better job for himself." This appears to be an accurate summary of the situation. Trade Unionism, as it seems to us, breeds selfishness. Every member of a union has an equal right to vote. He votes in his own interest. In his own interest he joins with his fellows in keeping down the number of apprentices. If he is a young unmarried man, a strike affects no one save himself, but he wholly forgets that for an older man to be thrown out of work may be a serious matter for a poor woman and a number of children. So long as the strike pay comes in regularly, the fact that he is out of work is of little moment to a man of this stamp. It is the chance of an occasional holiday which keeps such men on the rolls of the unions.

But it seems that there are a number of men throughout the country who have come to the conclusion that it is no bad thing to be free from the trammels of trade unionism. As we recently showed, the National Free Labour Association has a membership of 680,000. This ought to be sufficient to show the working man that there are other powerful organisations besides trade unions that have his interests at heart.

Electrifying a Single-track Road.

The *Railway and Engineering Review* (Chicago) for September 12th contains extracts from a paper read by Mr. J. B. Whitehead before the Am.I.E.E. which are well worth careful study, on account of the nature of the problem. Most of the attempts hitherto made to prove that main steam railways can be converted to electric locomotion have been concerned with the heaviest services on double-track systems, but the present paper deals with the conversion of a lightly loaded single line, of sufficient length to make the conclusions highly important to railway companies in every country in which the conditions are at all similar, and particularly in the United States, where about 60 per cent. of the total mileage is single track.

The example taken by the author is a standard gauge road 29¼ miles long, between Baltimore and Annapolis, including a branch 4 miles long. The steam service which is now being superseded supplies seven trains per day, averaging three coaches per train, in each direction, and the average car-mileage is 30,000 per month. The one express train per day makes a schedule speed of 33·7 M.P.H., with five intermediate stops, while the ordinary trains make 25·25 M.P.H. with 15 stops. There is also one goods train each way daily, and occasional large excursion traffic.

Electrical service will provide single-car trains run on a half-hour headway in the busier hours, and half that service at other times. The cars seat 62 passengers, and can be operated in multiple to increase the car-mileage when necessary, but for possible concentrated loads recourse will be had again to steam. Power is to be bought from a Baltimore company.

It was realised from the outset that the change could not be justified on the ground of increased economy of operation, as the increase in fixed charges out-balanced the possible economies obtainable with electrical working, but other considerations were deemed important enough to justify the change. The preliminary estimates for the case in point foreshadowed an increased total operating cost of electricity over steam of about 16·6 per cent., the same car-mileage being assumed, and the management look for an improvement in the local traffic to compensate this increased cost. At present the earnings from local traffic represent about 25 per cent. of the total. The ratio of running costs to revenue is 65 per cent., so that, with unchanged traffic conditions, the ratio will be increased to 76 per cent. under electric service; but it is only necessary to assume that the local traffic will be doubled, to reduce the ratio to less than its present value, and, as there is practically no competition in local traffic, the results of a frequent electric service in other localities indicate that such an increase in this instance is not improbable.

In estimating the relative advantages of D.C. and A.C. for the service, it was considered that the single-phase A.C. system was the only available A.C. system which had shown itself to be commercially successful in the States, and that the D.C. system had no advantages so far as actual working conditions were concerned; so that the choice was based on a comparison of the 25-cycle single-phase system, with the 600-volt D.C. system. This comparison was made from the standpoints of first cost and working expenses, and the result was found to favour the A.C. system. Some account of the process of comparison is given in the paper.

The A.C. car weighs 5 tons more than the D.C. car, but in spite of that fact the former requires less energy for the run, this being due to the resistance losses in the D.C. car. The maximum power reached by the A.C. car is greater, but it is applied for a comparatively short time.

The following comparative table of capital cost was based for the most part on actual tenders:—

	D.C.	A.C.
Nine cars equipped	$107,300	$149,300
Catenary trolley, poles, wires and guys	—	75,000
Third rail	132,000	—
Transmission line	65,000	36,000
Power house apparatus ...	21,000	62,000
Sub-station apparatus	39,000	8,000
„ buildings	15,000	3,000
Bonding	18,000	11,000
	$397,000	$344,300

In power consumption, the two seem to be on an equal footing, which is surprising, since the motor-generators reduce the efficiency of the S.P. system greatly; but this is offset by the losses in rotaries, the excess loss in distribution, and the increased power consumption at the car, due to the smaller motors and short runs. The D.C. system requires three sub-stations, which have no counterpart on the other, and the cost of attendance would be $54,000 per annum.

On the other hand, the cost of maintenance and repairs of car equipments would be about 0·5 c. for the D.C. system, against 0·75 c. per car-mile for the A.C. system.

Finally, the author finds a total of $8,865 (say £1,773) in favour of the A.C. system.

American "Highwaymen."—The railway train squashed out the English highwayman, but the following extract from an interview with the Chief of the Secret Service Department of the Union Pacific proves that the days of so-called romance are by no means over on the American Continent:—"At this time of the year we are always prepared to protect our trains. In addition to guards on all trains, the Union Pacific is still maintaining its equipment for the pursuit and capture of highwaymen, whether successful or not. It consists of a car of well-bred, strong and fast horses, which can be loaded up at a moment's notice. This car, with a caboose stored with saddles, bridles, camp outfit, arms and ammunition, makes up a special train, which can be started for the scene of a hold-up almost immediately upon the news reaching headquarters." But the modern highwayman rises superior to that kind of trap or chase, for he is an expert telegraphist, and can direct the "almost immediate" movement of the special train to suit his own plans after he has held up the mail and dynamited the specie car.

D

THE MOOSBURG-MUNICH 50,000-VOLT POWER TRANSMISSION PLANT.

[BY OUR BERLIN CORRESPONDENT.]

The municipal electricity works of the city of Munich have been gradually developed from small beginnings, 15 years ago, to a very extensive power plant.

When that city, in 1893, erected its first hydraulic power plant on the River Isar, it was confined by an agreement

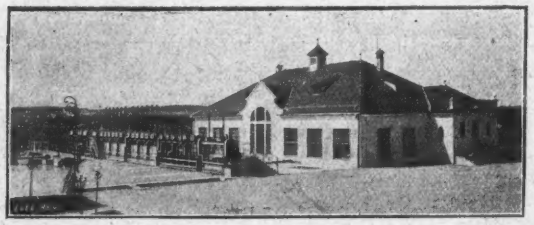

Fig. 1.—Uppenborn Electricity Works.

with the Gas Light Co. to an output of 300 H.P. An extension of that plant was effected in 1896, but the output could not even then be raised beyond a maximum of 600 H.P., apart from the power generated for tramway purposes.

An unhampered evolution did not begin before 1899, when dependence on the gas company having been discontinued, the Isarthalstrasse Electricity Works (driven by steam engines) was put into operation in the south of the city. This central station comprised five generators, each of 800 KW., and supplied three-phase current at 5,000 volts pressure, to be converted in sub-stations into continuous current for tramway and lighting purposes.

As the current consumption increased, however, this steam-operated electricity works proved unable to cope with the growing demand. Two hydraulic power plants were, therefore, erected, one of which is situated in the southern part of the city on the upper Isar, close to Maria Einsiedel station. The generating plant, which was put into operation at the end of last year, comprises three Siemens-Schuckert polyphase-current generators of 1,300 H.P. each.

The other power plant, viz., the Uppenborn Electricity Works, near Moosburg (fig. 1), which was inaugurated in the middle of last year, is situated at about 54 km. to the north-east of Munich on the lower Isar, and comprises three Siemens-Schuckert three-phase generators, each of which yields 1,400 K.V.A. at a pressure of 5,000 volts, being driven by turbines constructed by J. M. Voith (fig. 3). A three-phase generator of 210 K.V.A. and 5,000 volts serves for supplying current to the town of Moosburg, and a converter set and accumulator battery are used for the continuous-current lighting plant of the power station.

The current generated in the large three-phase machines is raised in two transformers of 2,000 K.V.A. each to a pressure of 50,000 volts, at which it is then conveyed to Munich over a transmission line 54 km. in length. This transmission line, constructed by the Munich Electricity Works itself, runs alongside the River Isar, and consists of two parallel lines with three copper cables of 16 sq. mm. each. It terminates at the Hirschau transformer station (fig. 2) erected in the northern part of the City of Munich, where the pressure is lowered again to 5,000 volts by means of two transformers of 1,800 K.V.A. each.

The devices used as safeguards against surges at the 50,000-volt end, as well as at the Moosburg power house and Hirschau transformer station, are mainly identical with those employed in connection with the 50,000-volt power transmission plant from Kykkelsrud to Hafslund, Norway, described in the Electrical Review of October 23rd.

The stage-choking coils inserted at the transformer station into each conductor are represented in fig. 4; from

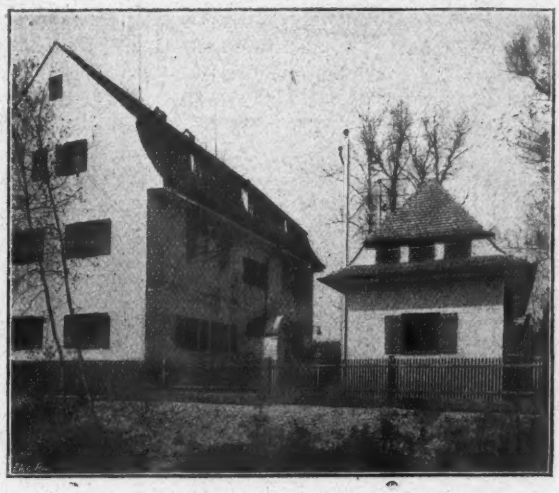

Fig. 2.—Hirschau Sub-station and Lightning Arrester Cabin.

these coils are branched off conductors leading across lightning arresters installed on the upper floor and oil resistances (visible in fig. 4) down to the ground. Protective choking coils, seen in the left-hand part of the figure, are used for damping high-frequency oscillations, and a water-jet grounding device (fig. 6) allows of a gradual absorption of high pressures, so that the lightning arresters are actuated but seldom.

The horn lightning arresters (fig. 5) installed in a special building beside the transformer station serve as safeguards

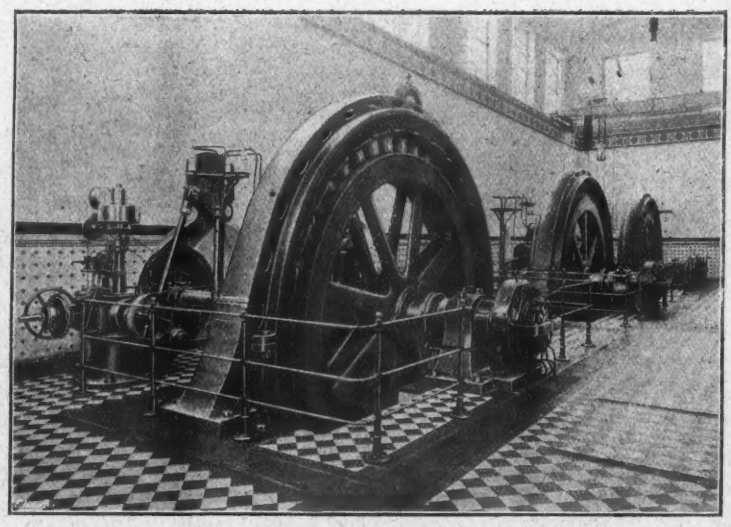

Fig. 3.—Interior of Generating Station.

against violent atmospheric discharges; they are connected through a switch to the conductors and to the ground across a water resistance. Similar lightning arresters are situated at the Uppenborn power station and in the middle of the transmission line near Achering, where the conductors can be divided into two portions by a section cabin. Having in view the high pressure of 50,000 volts, the excess-pressure safeguards were given specially ample dimensions.

The switchgear at the 5,000-volt end comprises seven removable switching cells, of which six are at present in

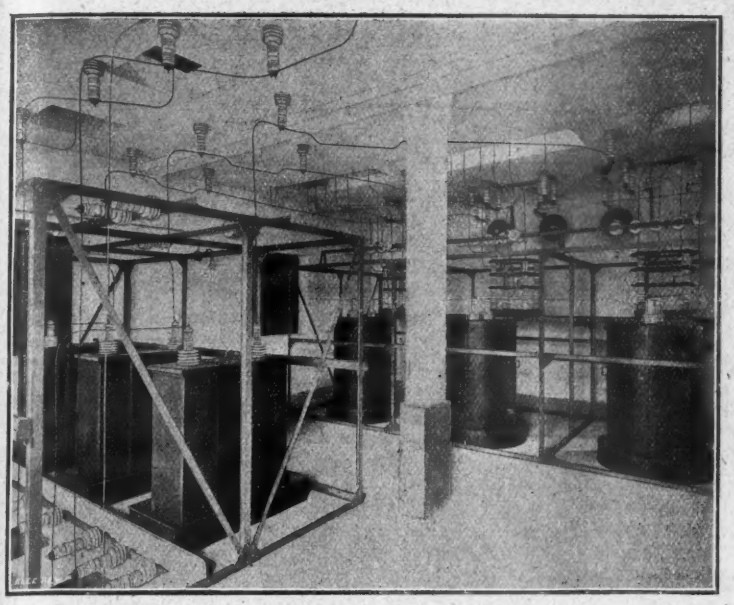

Fig. 4.—Protective Devices at Hirschau Sub-Station.

operation. These are used for the two transformers and the four 5,000-volt cables leading to the urban stations respectively. The Hirschau transformer station is by these cables connected up in parallel to the steam-operated electricity works in the Isarthalstrasse.

THE ELECTRIC DRIVING OF FACTORIES.

It is nowadays fully recognised that the electric motor offers a valuable means of driving that cannot be overlooked, and in every scheme of factory operation the advantages of electricity as contrasted with other agents are taken into

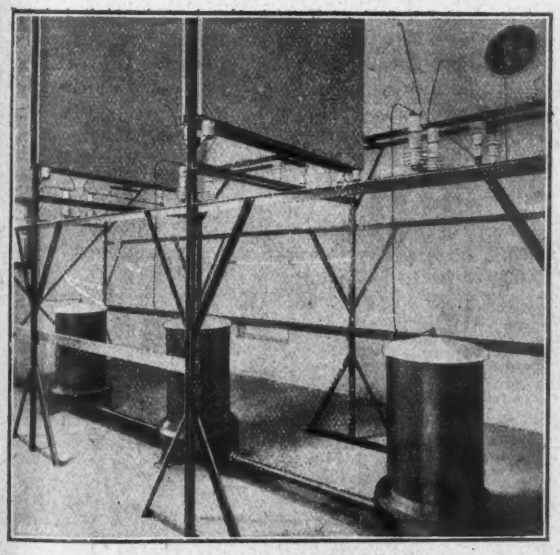

Fig. 5.—Transformer and Water-Jet Earthing Device, Hirschau.

account. There are, however, a large number of considerations which enter into the question besides the item of first cost, considerations which powerfully affect the subsequent running charges; and it is not to be wondered at that very frequently the issue becomes confused.

Taking, for example, the first difficulty which meets a man who wishes to drive his factory with the best and cheapest form of power, he finds that there are a considerable number of alternative sources of power. There is the old-established and generally reliable steam boiler and engine working on to shafting. There is the possibility of using a gas engine operating off a town supply, and in these later days the uses of suction gas have been much proclaimed. Electrical drive is not at all a universal panacea for power troubles. He has to consider what effect the ease of stopping, starting and changing speed will have on his works production, the ground rent value of bringing tools to the work instead of the reverse process; the sizes of various classes of driving mechanism, and the advantage or otherwise of grouping various classes of machines on to one shaft.

If he is established within the reach of the supply mains of a large electric power system, it is frequently a matter of debate whether he shall install his own private plant or make use of the power mains. He is influenced by considerations of capital outlay, of wages bills, of continuity of supply, and of the facility for increasing the capacity of the plant at any future time.

The question as to the best way of applying electric motors to the driving of factories and workshops, so as to make full use of these advantages and at the same time obtain the most economical results is, therefore, a difficult one to answer. In dealing with new works, probably the ideal drive would be one motor for each machine. This principle is gradually being accepted as correct by machine makers, who slowly but surely are building new machines with the motor as an integral part, and this holds good, not

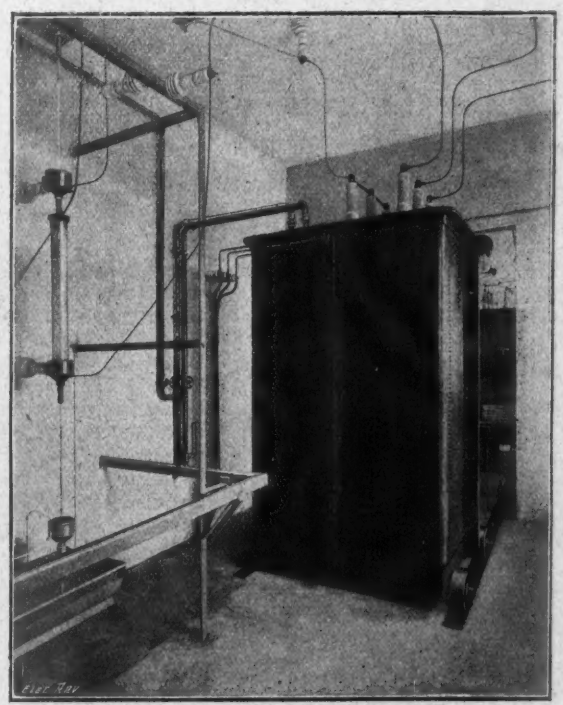

Fig. 6.—Lightning Arresters and Water Resistances in Cabin, Hirschau.

only for large machines, but for the smaller ones also. The electrical equipment of new works is a straightforward job, for the plant can be chosen and arranged to suit the man who works, the man who pays, and the class of machine to be driven.

When we come to consider the conversion of works with existing power plant, the case is different, and, perhaps, the advantages are not so evident.

To successfully apply electricity to this class of power

user, it is, as a rule, necessary to do away with a considerable amount of plant and shafting, all of which represents capital to the possible consumer, while, at the same time, he will have to find further capital to provide the new installation. It is the better class of consumer who calls for the greatest ability on the part of the engineer who has the arranging of the new drive. Converting works to the motor drive is undoubtedly a problem of much difficulty, and yet we often find the conversion undertaken by the man who puts in the lowest price, irrespective of his capability of carrying out the work, with the result that change-overs to electric driving are occasionally failures. In this connection it might be pointed out that electric driving does not of necessity reduce the working costs, even if prices are very low, unless its application is undertaken with the aid of practical experience and careful thought. In some cases we find the problem solved by the substitution of one motor for the original prime mover, while in others the whole works are cut up into small individual drives by separate motors. Now, under average conditions, neither of these are really successful solutions to the question, and both methods have done much to retard the general adoption of motors in works and factories. The first case, that of substituting a motor for the original source of power, is hardly ever right, for by this means, the heavy shafting losses are still continued, and there is a great probability of the motor being overloaded. The other extreme, again, in the great majority of cases, is also not to be recommended, for the initial capital outlay is so great that the interest on this alone is considerably more than the losses that would take place in the shafting, &c., replaced, while the increase in the number of motors necessitates a larger outlay of spare parts.

The question arises then as to what should be the lines on which to consider the conversion of works from an existing steam or gas drive to that of electric motors. In this consideration it must be evident to all, that there is a point between the two extremes above mentioned, at which the interest on capital more than balances the cost of losses in shafting. The condition of greatest economy in factory or works driving should be such that the total annual cost arising directly or indirectly from the distributing system, either electrical or mechanical, should be a minimum. This total yearly expenditure on the distribution system is made up of the annual cost of units wasted in driving shafting, motors, &c., the annual cost of installation for distributing power, and the annual cost of repairs and maintenance.

These three items will all vary with the installation, the method of drive adopted and the hours run per year. In most cases item one will be a maximum when one motor is used to drive, and distribution takes place by shafting, and will decrease as the number of motors is increased, and shafting reduced. Item two, on the other hand, will be a maximum for the individual drive, and will decrease as the number of motors is reduced. The third item will remain approximately constant, with a tendency to increase with the number of motors used.

How, then, are we to decide, in each case, what is the best combination to adopt, to obtain the greatest economy of working and initial cost? This can only be answered by practical experience and careful consideration of each individual case on its merits, for as yet no law has been evolved which combines all these three variables together.

It will hardly be necessary to dwell on the advantages of electrical transmission as compared with mechanical, but as a general rule experience tends to show that below 5 H.P. (in most cases) it is better to transmit mechanically, while over this the advantages lie entirely with electrical transmission. The loss of power in driving long lengths of shafting and belting is a very large proportion of the total power developed. This is very often ridiculed by owners of works, and even by some engineers, but it can be proved when electric motors are used for driving. The power taken by a motor being easy of correct measurement, for any condition of load, it is possible to find exactly what is required to drive shafting and belting, under usual working conditions. This has been found in some cases to be as high as 70 per cent., while in others it has been found to be as low as 20 per cent., the former being where the shafting is heavy and extensive, and the latter being in cases of compact and well maintained systems in this connection. It may be interesting to note that for approximate estimating purposes the average loss per bearing may be taken to be ·25 H.P., per 100 ft. of shafting, 5 H.P.; per 100 lb. of shafting, ·25 H.P.; and per belt, ·3 H.P.

The older methods of factory driving which one has to contend with and adapt to electric driving fall under three headings:—(1) Works driven by one large engine with shafting, &c.; (2) works driven by scattered engines supplied by one central bank of boilers; and (3) works driven by scattered engines and boilers. In Class 1, the engine will generally be of the compound condensing type, but the shafting losses will be considerable, rarely being as low as 20 per cent., generally approaching 70 per cent. Although the actual cost of generating a horse-power-hour will be a minimum with this class of drive, yet it is an ideal one in which to show a saving (due to reduction in distribution losses), by the application of motors. With electric motors, the transmission losses may be taken as from 10 per cent. for large sizes to 25 per cent. for the smallest sizes used, these figures including losses in both wiring and motors.

In converting this class of factory, the existing drive will undoubtedly have to be split up amongst several motors, doing away with all main drives as much as possible. The number of motors will, of course, depend on the class of work done, attention being paid to the following considerations. All machines of over 5 H.P. which run for a small percentage of the working hours, should have separate motors direct driven, either by belt or gearing. Machines under 5 H.P. running for short periods should, if possible, be grouped on to one motor. Machines running all day should be grouped on shafting and be driven from one large motor, say not exceeding 25 H.P. Large machines, whether running all day or only for short periods, should have separate motors driving them. In grouping for constant running, it is well to keep the steady loaded machines on the same motor, and the variable ones on another.

In Class 2, although steam may be generated efficiently from a central bank of boilers, it cannot be transmitted through long lengths of piping with economy, and in such cases the engines will be small and expensive in steam consumption. The loss from condensation in steam piping amounts to about ·5 ton of coal per annum per square foot of uncovered pipe if continually under steam and exposed to the atmosphere, and even with the best lagging, this will only be reduced to about ·166 ton per annum. It will be seen, therefore, that such a system of power distribution is most unsatisfactory, and very costly to work. Further, these small engines are usually of the low-pressure non-condensing type, and the average consumption of steam may be taken as 100 lb. per indicated horse-power. This, with good coal and efficient boilers, gives about 10 lb. of coal per indicated horse-power-hour.

It will be seen, then, from this that the possibility of showing a saving in working costs by the conversion of this class of drive to electric motors is considerable, and as the amount of shafting will be less, the grouping is, to some extent, already arranged. The same general considerations will apply to this, however, as to that of case one, so far as the sub-division of drives is concerned. In Class 3 the cost of fuel and labour is obviously very expensive, and it is, therefore, the easiest system to compete with, and, at the same time, the one that will show the best results from conversion.

The whole question of adopting electric driving depends on the capital outlay required, and there is a tendency in consequence of this to cut down the initial outlay at the expense of running costs. It is evident, however, that if the necessary money can be obtained at low interest it is better to have the annual cost made up of interest on capital, which can be paid off, than have it made up of distribution losses, which are continuous and cannot be recovered.

At the present time, of course, money for investment is rather difficult to obtain, and it may, therefore, be found in future that electric factory equipments completed in the years 1907-8 possess in a good many cases inefficiencies in drive which must not be put down to relative inferiority or superiority of any particular form of motive power, but simply to a short-sighted policy adopted by owners of

factories or their advisers, due to the temporary stringency of the money market. It should, therefore, be the aim of all skilled engineers interested in this question to impress upon their clients the real money value of spending a little more on their equipment, with the object of securing satisfactory operation over a long term of years.

TANGLED TOPICS.

By INNOCENS.

Does publicity pay?

Supposing that a benevolent philanthropist were to approach any of our well-known and respected Borough Electrical Engineers, and to guarantee the addition of 600 KW. with a load factor of ·8 to the station output, if the said Borough Electrical Engineer would, for the space of half an hour in each day, for one week, excluding the Sabbath, stand on his head in the market square, I wonder what would be the minimum price per unit that the Borough Electrical Engineer would demand? In other words, at what price would publicity pay?

The question is not quite so silly as it sounds, because we have for the last year or two been inundated with boostful literature designed to show how inexpressibly tortoise-like our English movements are, compared with the head-long methods adopted by the people over the water, commonly known as the juice-slingers. Signs of the times are not wanting, that before long we shall have an "All Together Boys" combination which will exceed the best operatic company in its vocal accomplishments and stage effects.

The Manchester Electrical Exhibition is another phase of this vexed question. Corporations, manufacturers, contractors, and caterers, have combined to astound the Lancashire lads and lasses, and the result is surely eminently gratifying to the organising genius of the promoters of the Exhibition. I do not suppose we shall ever know whether, on the whole, the Exhibition paid for itself in the sense of covering the enormous value of goods displayed, and in many cases especially prepared for the Exhibition, but I would point out that the very fact of such a show being held is a distinct departure from the conservative attitude of British firms and Corporations. They no longer dispose themselves in a comfortable attitude in the office, waiting for the postman to call with orders; they go out and hammer their thumb nails putting up fancy festoons.

We are beginning to realise that the bee that gets the honey doesn't loaf about the hive.

At the same time, it must not be supposed that we are henceforth going to play the noble game of nap with the cards upon the table. Be it far from us; else, where would be the fun of the fair? Even at the Exhibition the voice of doubt as to rabid publicitis was raised. It would obviously be unfair to reveal the nature or name of the firm, so let us say that we were talking about the introduction into England of the manufacture of electrolytic ice cream. The way in which this well-known product of electro-chemical activity became a British manufacture was as follows:—The head of a London firm making galvanised sugar candy happened to be travelling on the Continent near to Blanc Capelle, and picked up and casually read the piece of paper which had enclosed his supper of fried fish and chips. Therein, he saw an advertisement of the American Eagle Electrolytic Hokey-Pokey Combine, giving a minute description and chemical formula of the compound, together with a list of the principal firms to which it was supplied, and the number of tons sent out per year. The head of the London company immediately concluded that the hokey-pokey line was a good one to go into, got interested, went home, collected price lists and men who knew, launched the electrolytic ice cream, and kicked the Yankee company into Jupiter. Which simply shows that the original advertisement didn't do all that it was intended to do.

As a contrast to this, I may mention a case of publicity that does pay. About 7 o'clock in the evening, I, being a visitor at the Manchester Exhibition, got academy headache and went out into the city to get what is commonly known as fresh air. And as I wandered through Piccadilly I was practically blinded by a flare of electric light that looked like a sun spot. On steadying up (it was still early in the evening) I investigated the phenomenon and found it to be an Abode of Mirth, or some such diversion. The walls and ceiling were ablaze with lines of glow lamps. The front of the show was enough to put everlasting despondency into Halley's comet, but the real gist of the matter—the money-making end of the concern—was a collection of peepshows and phonographs. I did not examine the exhibits, as excessive bashfulness was always one of my greatest failings, and there was such a crowd of Manchester mill-girls, all laughing, in the Abode of Mirth, that my courage failed me, and I went off miserably, holding my Exhibition catalogue like a deacon going to church. But the lesson was not lost; here is an undertaking subsisting on coppers (a ha'penny was, I believe, the charge), yet flourishing in one of the most expensive streets in Manchester by the aid of judicious publicity.

The moral of which is, not that electricity is the best advertisement, but that in publicity, interesting and attractive matter is imperatively necessary. The juggler by his spangles, his small talk, his pistol, attracts the gaze of the crowd, while his other hand is busy manipulating the trick. The successful advertiser makes all the fuss imaginable with the spangles, and keeps a dumb man in the back office drawing up contracts and specifications.

CORRESPONDENCE.

Letters received by us after 5 P.M. on TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Traffic on Lincoln Tramways.

My attention has been called to a statement *re* Lincoln tramways, which appears in your issue for the week ending September 18th last, and which is apparently an excerpt from a paper read by Mr. F. Douglas Fox, before the British Association.

The statement referred to is to the effect that each member of the Lincoln population rides only 27 times per annum on the tramways, and attention is called to this in the paper, as being by far the lowest figure for any town in the country. In estimating this figure, Mr. Fox has taken the population of Lincoln and the two or three surrounding rural authorities. It should be pointed out, however, that at present only one end of Lincoln is served by the tramways, that is, only about one-quarter of the route mileage which was authorised in the Lincoln Tramways Act. To obtain, therefore, the true riding habit in Lincoln, only the population which the tramways serve should be taken; in other words, a maximum of 20,000 in lieu of 55,000, which would give a figure of 75, in lieu of 27, the extremely low one mentioned.

Stanley Clegg,
City Electrical Engineer.

Electricity Works, Lincoln, *October 22nd*, 1908.

Our Consular Agents.

In the Commercial Supplement of last Friday's *Times*, there was an article from a correspondent dealing with British Consulates abroad, taking Germany as an example.

The following extracts may be of interest to those who did not see this article of two columns.

Referring to Consuls who are paid for the work that they do, there are only five salaried British Consulates, including two vice-Consulates in the whole German empire, with a population of 62 million and a foreign trade of £760,000,000. These Consulates are at Hamburg, Stettin, Danzig, Bremerhaven, and Emden, all sea ports, and most important centres for shipping and import and export trade.

There is not a single salaried British Consul in the whole

of inland Germany. Unsalaried Consuls, who are Germans, represent British trade at important trade centres like Berlin, Leipzig, Frankfurt, Dresden, Cologne, Munich, Mannheim, Breslau, and Nuremberg.

Forty years ago, when the population was 20 millions less, the salaried Consular representation of Britain was better. In 1866 there were nine paid British Consuls receiving salaries amounting to £5,575, whilst to-day there are only four such officials receiving £5,665 per annum, £3,015 of which goes to the Hamburg Consulate alone. In the sixties £750 was paid to the Consulate at Leipzig, £200 to Cologne, with populations of 90,000 and 120,000 respectively. To-day, with populations of 510,000 and 430,000, not a single salaried British Consul is found in these towns. The United States employ 23 Consuls, costing £18,000. They increased exports to Germany from 11 millions sterling in 1886 to 54 millions in 1907, whilst the imports from Germany rose in the same period from 14 to 29 millions.

It is then pointed out that in France at least there is some representation. In France with 40 million inhabitants against Germany's 62 million, there are 11 salaried British Consuls at an annual outlay of £10,000, as against £5,000 to five British Consuls in Germany. Two of the Consuls are located at French inland towns, Lyons and Rouen.

Perusal of the original article would give fuller information.

London, *October 20th*, 1908.

P.S.—You will no doubt have seen in a later issue of the *Times*, that Mr. Francis Oppenheimer, H.B.M.'s Consul-General at Frankfort, writes to point out that though German in name he is English by birth and education; also that he is in the position of being able to represent British trade without remuneration. If the *Times* correspondent makes a mistake of this nature with such an important Consulate, what must be the knowledge of the public at large on this subject?

Ex-electric.

October 26th.

Auto-Transformers.

I have read the interesting article on auto-transformers in your issue of October 16th, and think it explains the whole matter in a very lucid way; but I cannot help thinking, when people go into figures, that they ought to take care that their figures will be substantiated by actual facts. I refer to the statement of initial outlay, and notice that Mr. Cateaux puts the cost of the lamps and the transformer at £14 2s., and so shows an extra initial outlay of £10 8s. over ordinary carbon lamps. I think, however, it would have been better to state that, beyond this outlay, would be the very necessary one of fixing and connecting the transformer, which, of course, varies according to circumstances; and he might have suggested an approximate figure for this, or, at all events, if he had alluded to the matter, there could be no possible cause for criticism.

I understand that some companies require a control switch to be fitted, while it is generally admitted that such an arrangement is advisable for houses as well as for shops and offices to prevent, during the day, any current from passing through the transformer.

F. D.

Magnet Steel.—A correspondent desires to be placed in communication with makers of permanent magnets and magnet steel of the best quality.

THE PRODUCTION OF FINISHED IRON SHEETS AND TUBES IN ONE OPERATION.

By SHERARD COWPER-COLES.

(*Abstract of paper read before the* Iron and Steel Institute, *September*, 1908.)

The object of the present paper is to describe an electrolytic process for making tubes, cylindrical vessels, sheets and wire in one or two operations from crude or scrap iron, or direct from the ore, without the processes of smelting, rolling, or drawing, at a cost that has hitherto been thought impossible. Electrolytic iron can be obtained almost chemically pure when special precautions are taken. The cost has been reduced to about ½d. per lb. for iron obtained in a finished form capable of realising the highest market value.

Iron Sulpho-Cresylate; Saturated Solution.

Temperature. Degrees C.	Current density. Amperes per square foot.	E.M.F. at electrodes; volts. Stationary mandrel.	E.M.F. at electrodes; volts. Revolving mandrel.
23	25	2·00	1·95
90	25	0·85	0·85
23	50	3·50	3·40
90	50*	1·70	1·70
23	100*	5·00	4·95
90	100	2·40	2·35

*Only 4·5 instead of 6 amperes could be passed through the solution at voltage available.

The process briefly consists in placing crude iron (which may contain those elements which are at present so detrimental to the production of high-class iron or steel), or finely divided iron ore, in suitable containing vessels in which an acid solution is circulated, using an insoluble anode material; or, further, the process may combine the use of soluble and insoluble anodes. The crude iron or iron ore being in each case connected to the positive pole of a dynamo, the iron goes into solution, and is deposited on cylinders or plates which may be either rotated or stationary, depending upon the class of finished product required.

Good results have been obtained from an ore containing per cent.:—Ferric oxide, 50·7; lime, 3·8; phosphoric acid, 1·51; alumina, 10·0; silica, 16·0. When it is desired to produce a highly-finished sheet, a metal sheet of the desired surface is wrapped round the cathode, and held in position by means of grooves and wedges. In this way sheets of large dimensions can be made; by employing a mandrel, say, 8 ft. in diameter, a sheet 24 ft. × 5 or 7 ft. can be produced. When it is desired to produce tubes, iron mandrels, somewhat smaller than the internal diameter of the finished tube, are coated with lead by electro-deposition, or by having lead drawn over them. Thus prepared, the mandrels are rotated in a suitable apparatus; when the desired thickness of iron has been deposited the mandrel is heated to a temperature sufficient to melt out the lead, and thus admit of its easy withdrawal.

The electrolyte employed consist of a 20 per cent. solution of sulpho-cresylic acid saturated with iron. In some cases it is advantageous to add small quantities of carbon-disulphide, the temperature of the solution being about 70° C., and the current density about 100 amperes per sq. ft. The solution is kept charged with iron oxide, which is kept in suspension in the electrolyte by means of stirrers, by moving one or both of the electrodes, or by circulating by means of a bucket pump. The specific gravity of the electrolyte having the iron oxide in suspension is about 1·32.

Excellent results have also been obtained by depositing the iron in a closed cell with a vacuum of a few inches, and also with a chloride solution and porous cells, bleaching powder being produced as a by-product; or the chlorine utilised to form fresh iron chloride.

The following are two typical analyses of electrolytic iron produced under the conditions described in this paper:—

	I. Per cent.	II. Per cent.
Carbon	0·060	under 0·05
Silicon	0·011	0·048
Sulphur	0·016	0·045
Phosphorus	0·041	0·04
Manganese	traces	traces
Arsenic	0·004	0·01

Amongst other applications the process can be applied to the production of bi-metallic tubing and plates; that is to say, to tubes or sheets coated on the one side with copper or other metals or alloys.

The process can also be applied to the direct production of large sheets or strips representing the cutting surface of a file, and cut up into portions of the desired shapes, and secured to suitable backing, to form separate files. The prints are produced by making a continuous impression or a number of impressions from a suitable die, revolving roller, or reciprocating tool in a lead alloy. The matrix thus prepared is mounted on a revolving drum, and steel deposited by the process which has already been described.

Electrolytic steel, with considerable variation in the percentage of carbon, can also be produced. Houllevigue observed that when iron is deposited from iron containing uncombined carbon, the product at the cathode was free from carbon; but when deposited from iron containing combined carbon, the cathode product also contained carbon. The author's observations confirm this statement. The amount of silicon in the iron can also be considerably varied. An important feature of the electrolytic process will, no doubt, be the introduction of some new ferrous alloys, which cannot be made by fusion. Alloys of iron and nickel have already been produced electrolytically.

Electrolytic iron sheets can be obtained with a highly finished surface, can be readily welded, coated with tin and zinc by dipping in a molten bath of these metals, coated with zinc by the Sherardising process, or electro-galvanised, as will be seen from the samples exhibited.

The structure of electrolytic iron varies considerably, and in some cases it is found to be amorphous; whilst in other instances it possesses a structure somewhat similar to that of wrought-iron.

The structure is very minute as compared with wrought-iron, the crystal grains being elongated at right angles to the surface of the steel, and there is not the same tendency to form a definite crystalline structure as in the case of electrolytic copper, which always crystallises at right angles to the cathode surface. A weak

line of cleavage cannot be formed with the same precision as with copper.

The properties of electrolytic iron appear to depend largely on the amount of hydrogen present, and therefore on the annealing, which reduces or eliminates the occluded hydrogen.

Samples tested have given a hysteresis loss of under 0·3 of a watt per pound. The iron when charged with hydrogen is magnetic; and when magnetised, becomes a very powerful magnet as compared with ordinary steel.

Electrolytic iron always contains hydrogen in varying quantities, according to the conditions under which it is deposited, and the more hydrogen it contains the greater is its hardness. The hardest varieties will scratch glass. Longheber has found electrolytic iron to contain 0·2 to 0·001 per cent. of hydrogen. Although these figures appear small when expressed as weight percentage, they represent volumes of hydrogen to iron of between 12 and 110. When high current densities were employed, deposits were obtained containing 110 times their own volume of the gas. Other investigators have obtained even larger percentages of hydrogen.

There are two distinct varieties of electrolytic iron, with varying percentages of hydrogen; the softer kind of iron is silver-grey in colour, whilst the other variety is very hard and brittle, breaking as readily as glass, and containing a higher percentage of hydrogen. The hardness varies between these two extremes. A surface can be obtained on the latter of a silvery whiteness, and with a mirror finish without polishing. Either quality can be produced at will by increasing or decreasing the electromotive force at the terminals of the cell.

Iron highly charged with hydrogen is very inert, and not readily attacked by acids. The softer quality is also comparatively inert. Equal surfaces of wrought-iron and electrolytic iron were immersed in pure hydrochloric acid, 2° Twaddell, for eighteen hours. The electrolytic iron lost 2·48 per cent. of its weight, and the wrought-iron 13·13 per cent. The temperature required for annealing electrolytic iron is slightly in excess of that required for ordinary rolled sheets. Electrolytic iron, when heated in a closed annealing-box, gives off large quantities of hydrogen; and if a pipe is fitted to the annealing-box the hydrogen flame can be kept burning during the whole process of annealing, and for a considerable time after the heat has been removed from the annealing-box. This phenomenon has been turned to account for removing scale from ordinary rolled sheets by placing some sheets of electrolytic iron in an ordinary annealing-box with plates to be scaled. Electrolytic iron gives up considerable quantities of its hydrogen under 100° C. without losing its brittleness, and also when boiled in water or oil.

Conclusion.—The electrolytic production of iron and steel has now emerged from the laboratory or academic stage to a practical conception, enabling iron and steel to be produced in a highly finished form from iron ore or scrap iron, in a condition which realises the highest market value, by a process which reduces labour to a minimum, and under conditions which can be compared to the working of a central electric light station for cleanliness and health.

The estimated cost of plant for producing 5,000 tons of electrolytic iron in the form of tubes, sheets, and wire per annum, including iron under treatment, say, 1,000 tons, is £108,295; and the estimated cost per ton is £5 5s. 3d., or per pound, 0·56d.

Power can be obtained in Sweden at $\frac{1}{10}$ of a penny per KW., and would reduce the cost to £1 for the electrical energy per ton.

GAS PRODUCER PRACTICE.

In a paper on "Gas Producer Practice," by Messrs. W. A. Bone and R. V. Wheeler, at the meeting of the Iron and Steel Institute, reference is first made to a previous paper, in which it was pointed out that the admixture of more steam with the air blast of a producer than corresponded to a saturation temperature of 60° to 65° C. was not conducive either to higher thermal efficiency or to the production of a gas specially suited for furnace work. They now show how, with even less steam, rapid gasification and high thermal efficiency can be maintained over long periods, the gas being rich in carbonic oxide.

One of two producers working with mixed steam and air blast pre-heated to 250° C. was shut down, and the other one carried the load, though blown with a steam saturation temperature of only 60° C. This led to further experiment. From 7 ft. the fuel bed was reduced to only 3½ ft. above the bars, a depth sufficient to decompose nearly all the steam introduced in the blast with a saturation temperature not above 60° C., and the CO_2 produced was under 5 per cent.

The load on the producer was doubled to show how high a rate of gasification could be attained. The producer was 10 ft. in internal diameter, and its rated fuel consumption 16 cwt. per hour. This was raised to 23·6 cwt. during day shifts, or 47 per cent. overload. At night the fuel was 14 cwt. per hour, or 85 per cent. of full load rating. The gas was just as good by day as by night, though the output was so much greater. The coal was Lancashire (Collins Green) washed nuts, and the gas per ton was 135,000 cb. ft. at 0° and 760 mm. with nearly 46 per cent. combustible; the efficiency of the producer was 0·725.

When the steam saturation temperature was lowered to 55° C., the percentage of CO_2 in the gas was lowered by 0·7 and the carbon monoxide was increased by 0·8 per cent., with no appreciable change in the hydrogen. All the steam was decomposed. Again lowering the saturation temperature to 50° C. reduced the CO_2 to 2·5 per cent., and the hydrogen from 15·45 to 12·35 per cent., and increased the carbon monoxide from 28·1 to 30·6 per cent. The gas was thus, as it is described, ideal for power and furnace work.

At 45° C., on a 60 hours' trial, the gas quality was maintained, but it appeared that the lower limit was passed below which the steam in the blast could be reduced. The authors express their conviction of the greater furnace efficiency of CO as compared with hydrogen, and they adhere to the opinion previously expressed that a high percentage of CO is desirable for steel melting or reheating furnaces. In these columns we have always contended for power gas rich in CO, and the authors lean this way, too. Of the carbon in the coal, 92·2 per cent. was converted into permanent gas, and 6·5 per cent. appeared as tar, the rest—1·2 per cent.—being lost as coke or soot.

The general conclusion to be drawn is that a moderate amount of steam will give better results than that excess of steam that some engineers so much favour. Evidently one may pay too much for hydrogen in a gas. Only when the products of combustion are reduced to 0° C. can the full calorific value of hydrogen be obtained, and an equality claimed with carbonic oxide; since every heat engine rejects its working fluid above the temperature of 100° C., the available calorific power of hydrogen is only five-sixths of its nominal power, and carbonic oxide is actually much more powerful per cubic foot.

The authors of this very valuable paper call for more systematic and scientific study of producer gas than has hitherto been given to it.

INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS, 1908.

The Technical Committee resumed its sittings on Monday and Tuesday last week, and considered the steps to be taken to secure uniformity of the standards in the future, whether by establishing a single International Laboratory, or by making use of the four existing laboratories. Prof. Arrhenius moved that the respective Governments be invited to take steps to establish an International Laboratory, and this was carried by 13 to 6.

Resolutions defining the watt were adopted, and a series of resolutions relating to secondary or working standards were approved. The establishment of a Permanent International Commission for Electrical Standards was recommended, by 18 to 2, a committee of 15 to be appointed, in the meantime, by the President, to advise as to the organisation of the Commission and to perform other necessary duties in connection with the work of the Conference, in co-operation with laboratories possessing the necessary equipment for precise electrical measurements. It was decided, by 15 to 3, that steps should be taken with a view to combining future electrical Conferences with the International Conference on Weights and Measures. The specifications were also approved and sent forward to the Conference.

Report of the Conference.

The report shows that delegates were present from 21 countries, and also from the following British dependencies, namely, Australia, Canada, India and the Crown Colonies.

The total number of delegates to the Conference was 43, and their names are set out in Schedule A. The Conference and its Technical Committee each held five sittings. As a result of its deliberations, the Conference adopted the resolutions and specifications set out in Schedule B, and requested the delegates to lay them before their respective Governments with a view to obtaining uniformity in the legislation with regard to electrical units and standards.

The Conference recommends the use of the Weston normal cell as a convenient method of measuring both electromotive force and current when set up under the conditions specified in Schedule C.

In cases in which it is not desired to set up the standards provided in the resolutions of Schedule B, the Conference recommends the following as working methods for the realisation of the international ohm, the ampere and the volt:—

1. *For the International Ohm.*—The use of copies, constructed of suitable material and of suitable form and verified from time to time, of the international ohm, its multiples and sub-multiples.

2. *For the International Ampere.*—(*a*) The measurement of current by the aid of a current balance standardised by comparison with a silver voltameter; or

(*b*) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and international ampere, and of a resistance of known value in international ohms.

3. *For the International Volt.*—(*a*) A comparison with the difference of electrical potential between the ends of a coil of resistance of known value in international ohms, when carrying a current of known value in international amperes; or

(*b*) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and the international ampere.

The duty of specifying more particularly the conditions under which these methods are to be applied has been assigned to the Permanent Commission, and, pending its appointment, to the

Scientific Committee, to be nominated by the President (see Schedule D), who will issue a series of notes as appendix to this report.

The Conference has considered the methods that should be recommended to the Governments for securing uniform administration in relation to electrical units and standards, and expresses the opinion that the best method of securing uniformity for the future would be by the establishment of an international electrical laboratory with the duties of keeping and maintaining international electrical standards. This laboratory to be equipped entirely independently of any national laboratory.

The Conference further recommends that action be taken in accordance with the scheme set out in Schedule D.

Schedule A.—List of Countries and Delegates.

America (United States).—Dr. S. W. Stratton; Dr. Henry S. Carhart; Dr. E. B. Rosa.
Austria.—Dr. Viktor Edler von Lang; Dr. Ludwig Kusminsky.
Belgium.—Prof. Eric Gérard; M. Clement.
Brazil.—Mr L. Weiss.
Chile.—Don Victor Eastman.
Colombia.—Don Jorge Roa.
Denmark and Sweden.—Prof. S. A. Arrhenius.
Ecuador.—Sr. Don Celso Nevares.
France.—Prof. Lippmann; M. R. Benoît; M. de Nerville.
Germany.—Prof. Warburg; Prof. Jaeger; Prof. Lindeck.
Great Britain.—The Right Hon. Lord Rayleigh (President); Prof. J. J. Thomson; Sir John Gavey; Dr. R. T. Glazebrook; Major W. A. J. O'Meara; Mr. A. P. Trotter.
Guatemala.—Dr. Francisco de Arce.
Hungary.—Joseph Váter; Dr. Desiré Harsanyi.
Italy.—Prof. Antonio Ròiti.
Japan.—Dr. Osuke Asano; Mr. Shigeru Kondo.
Mexico.—Don Alfonso Castelló; Don José Maria Perez.
Netherlands.—Dr. H. Haga.
Paraguay.—M. Maximo Croskey.
Russia.—Dr. N. Egoroff; Col. L. Swentorzetzky.
Spain.—Don José Maria Madariaga; Don A. Montenegro.
Switzerland.—Dr. Fr. Weber; Dr. Pierre Chappuis; Dr. J. Landry.

British Colonies.

Australia.—Mr. Cecil W. Darley; Prof. Threlfall.
Canada.—Mr. Ormond Higman.
Crown Colonies.—Major P. Cardew.
India.—Mr. M. G. Simpson.
Secretaries.—Mr. M. J. Collins; Mr. W. Duddell; Mr. C. W. S. Crawley; Mr. F. E. Smith.

Schedule B.—Resolutions.

I. The Conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimetre as the unit of length, the gramme as the unit of mass and the second as the unit of time.

These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0·1) in terms of the centimetre, gramme and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gramme and the second; (4) the watt, the unit of power which has the value of 10,000,000 in terms of the centimetre, the gramme and the second.

II. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the Conference recommends the adoption of the international ohm, the international ampere and the international volt defined according to the following definitions.

III. The ohm is the first primary unit.

IV. The international ohm is defined as the resistance of a specified column of mercury.

V. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross-sectional area and of a length of 106·300 centimetres.

To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in Specification I attached to these resolutions.

VI. The ampere is the second primary unit.

VII. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the Specification II attached to these resolutions, deposits silver at the rate of 0·00111800 of a gramme per second.

VIII. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

IX. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

Specification I.

Specification Relating to Mercury Standards of Resistance.

The glass tubes used for mercury standards of resistance must be made of a glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimetre. The mercury must have a resistance of approximately one ohm.

Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed 5 parts in 10,000.

The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube.

The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0° C. as possible. The measurements are to be corrected to 0° C.

For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately 4 centimetres), and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the mass.

The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula—

$$A = \frac{0{\cdot}80}{1{,}063\,\pi}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)\text{ohm},$$

where r_1 and r_2 are the radii in millimetres of the end sections of the bore of the tube.

The mean of the calculated resistances of at least five tubes shall be taken to determine the value of the unit of resistance.

For the purpose of the comparison of resistances with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

Specification II.

Specification Relating to the Deposition of Silver.

The electrolyte shall consist of a solution of from 15 to 20 parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that not more than 30 per cent. of the silver in the solution is deposited.

The anode shall be of silver, and the cathode of platinum. The current density at the anode shall not exceed $\frac{1}{2}$ ampere per square centimetre and at the cathode $\frac{1}{10}$ ampere per square centimetre.

Not less than 100 cubic centimetres of electrolyte shall be used in a voltameter.

Care must be taken that no particles which may become mechanically detached from the anode shall reach the cathode.

Before weighing, any traces of solution adhering to the cathode must be removed, and the cathode dried.

Schedule C.—Weston Normal Cell.

The Weston normal cell may be conveniently employed as a standard of electric pressure for the measurement both of E.M.F. and of current, and when set up in accordance with the following specification, may be taken, provisionally,* as having, at a temperature of 20° C., an E.M.F. of 1·0184 volts.

Specificaton Relating to the Weston Normal Cell.

The Weston normal cell is a voltaic cell which has a saturated aqueous solution of cadmium sulphate ($CdSO_4$ 8/3 H_2O) as its electrolyte.

The electrolyte must be neutral to Congo red.

The positive electrode is mercury.

The negative electrode of the cell is cadmium amalgam consisting of 12·5 parts by weight of cadmium in 100 parts of amalgam.

The depolariser, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate.

The different methods of preparing the mercurous sulphate paste are described in the notes.† One of the methods there specified must be carried out.

For setting up the cell, the H form is the most suitable. The leads passing through the glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other.

The depolariser is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed.

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* See duties of the Scientific Committee, Schedule D.

† Notes on methods pursued at various standardising laboratories will be issued by the Scientific Committee or the Permanent Commission, as an Appendix to this Report.

The following formula is recommended for the E.M.F. of the cell in terms of the temperature between the limits 0° C. and 40° C.

$$E_t = E_{20} - 0{\cdot}0000406\,(t - 20°) - 0{\cdot}00000095\,(t - 20°)^2 + 0{\cdot}00000001\,(t - 20)^3$$

SCHEDULE D.

1. The Conference recommends that the various Governments interested establish a permanent International Commission for Electrical Standards.

2. Pending the appointment of the Permanent International Commission, the Conference recommends (*) that the President, Lord Rayleigh, nominate for appointment by the Conference a scientific Committee of 15 to advise as to the organisation of the Permanent Commission, to formulate a plan for and to direct such work as may be necessary in connection with the maintenance of standards, fixing of values (†), intercomparison of standards and to complete the work of the Conference (‡). Vacancies on the Committee to be filled by co-optation.

3. That laboratories equipped with facilities for precise electrical measurements and investigations should be asked to co-operate with this Committee and to carry out, if possible, such work as it may desire.

4. The Committee should take the proper steps forthwith for establishing the Permanent Commission, and are empowered to arrange for the meeting of the next Conference on Electrical Units and Standards, and the time and place of such meeting should this action appear to them to be desirable.

5. The Committee or the Permanent International Commission shall consider the question of enlarging the functions of the International Conference on Weights and Measures, with a view to determining if it is possible or desirable to combine future Conferences on Electrical Units and Standards with the International Conference on Weights and Measures, in place of holding in the future Conferences on Electrical Units and Standards. At the same time it is the opinion of the Conference that the Permanent Commission should be retained as a distinct body, which should meet at different places in succession.

* In accordance with the above, Lord Rayleigh has nominated the following Committee, which has been approved by the Conference, viz.:—Dr. Osuke Asano; M. R. Benoit; Dr. M. N. Egoroff; Prof. Eric Gérard; Dr. R. T. Glazebrook; Dr. H. Haga; Dr. L. Kusminsky; Prof. G. Lippmann; Prof. A. Roiti; Dr. E. B. Rosa; Dr. S. W. Stratton; Mr. A. P. Trotter; Prof. E. Warburg; Prof. Fr. Weber.

† This will include the reconsideration from time to time of the E.M.F. of the Weston normal cell.

‡ With this object the Committee are authorised to issue as an Appendix to the Report of the Conference Notes detailing the methods which have been adopted in the Standardising Laboratories of the various countries to realise the international ohm and the international ampere, and to set up the Weston normal cell.

PARLIAMENTARY.

London and District Electricity Supply Bill.

A SELECT Committee of the House of Commons sat on Monday to consider the above Bill which has already been considered by a Committee of the House of Lords, and which has passed second reading. Mr. Luke White presided.

MR. J. D. FITZGERALD, K.C., in opening the case for the promoters, said the Bill was commonly known as a Power Bill for the supply of electricity throughout the London area—an area which included not only London but large surrounding districts in Essex, Middlesex, Kent and Surrey. Similar power Bills had been passed during the past eight or nine years for nearly all the large industrial districts throughout the United Kingdom. The Bill proposed to incorporate a company, and to authorise that company to establish a large generating station at Barking in Essex on the banks of the Thames, and from that generating station to supply electricity in bulk and also to power-users under the limitations contained in the Bill. The supply was first to authorised undertakers in bulk. The question of the supply to London in this manner had been before Parliament for the last four sessions; it had been thoroughly discussed by Committees and by the Special Committee of 1906, so that every matter that could arise had been thoroughly discussed, and in coming to a decision now there was no fear that any consideration which ought to be taken into account had not already been considered. Of the urgency and importance of the question there could be no doubt. Every independent person and tribunal, including all the Committees of Parliament who had investigated the matter, had arrived at the conclusion that it was a matter of the greatest importance that London should be in a position to receive a cheap supply of electricity from some such scheme as the one now before Parliament. Having sketched the history of the electric lighting legislation in London, learned counsel said that the present scheme was substantially the same as that which was brought forward by the L.C.C. last session. The reason for incorporating outside districts in the proposed area of supply was that there were large districts outside the Metropolitan area suitable for the establishment of manufacturing enterprises, if only the manufacturer could be secured a cheap supply of power. In the proposed area there were 66 generating stations—exclusive of those belonging to railway and tramway companies; there were 29 different systems of generation, and 18 different systems of supply. Under such circumstances, a cheap supply on a large scale was impossible. His clients were convinced that the demand for electricity in the area would be enormous, if it could be supplied cheaply. As showing the economy which would result from the Bill being passed, Mr. Fitzgerald said that in the existing stations within the area the plant capacity was represented by an expenditure of £41 per KW., while in their station at Barking the plant capacity would be represented by an expenditure of about £11 per KW.—less than one-third. The accident at the Lot's Road station, which caused the stoppage of the tube railways had caused a number of opponents of the scheme to rush into print for the purpose of pointing out how dangerous it would be for the well-being of London if a Bill of this kind was passed, because, they said, if there was a similar accident at Barking, the whole of London would be plunged into darkness. The answer to that was that under the scheme which they proposed, a calamity of that kind could never happen. The Barking station was designed on the unit principle. It was made up of six units or sections, and each section was a generating station of its own, and if an accident were to happen in any one of the units, it would not affect the supply of the remaining five, and no inconvenience would arise in consequence. On the other hand, he might point out that if their scheme had been in existence, and if the proprietors of the Lot's Road station had taken the precaution, which no doubt they would have taken, of having a proper connection ready to be laid on in case of accident to their station, the inconvenience which was felt by the stoppage of traffic would have been reduced to a minimum, as they would have been able to get a supply from Barking.

Proceeding to discuss the details of the Bill, learned counsel said that it would be purely optional on the part of existing companies or local authorities whether they took a bulk supply from the promoters or not. He believed that if the Bill was passed it would be found that a good many authorised distributors would come to his company, because it would be commercially profitable to them to do so. Then they looked for a very large demand from power-users in the area which would include most of the suburban railway lines, tramway companies and manufacturers. Proceeding to deal with the purchase clause, Mr. Fitzgerald said that up to the present no Power Bill had contained any such clause.

THE CHAIRMAN: I see you have not altered the clause in pursuance of the instructions of the House.

MR. FITZGERALD: No, because the exact form of the alteration of the clause will have to be considered, but, of course, we are bound by the instructions of Parliament, and we must carry them out.

MR. BALFOUR BROWNE: The sooner that alteration is made the better. We should like to see how those instructions are going to be carried out.

MR. FITZGERALD: I am told that when an instruction is given to a Committee by the House, the promoters don't alter the Bill—it is left to the Committee to carry out the instructions of the House. For that purpose, however, it is desirable that a form of words should be put before the Committee, and that shall be done. Continuing, learned counsel said that the idea of the promoters was that the question of the purchasing authority should be left open until the time for purchase arrived; but as Parliament had instructed that the L.C.C. was to be the authority, they would, of course, bow to that decision. Having explained the provisions with regard to purchase, Mr. Fitzgerald detailed the financial clauses of the Bill, and said he believed there was little doubt but that the money required to launch the scheme would be forthcoming.

At the conclusion of Mr. Fitzgerald's speech, engineering evidence in support of the scheme was proceeded with.

At the resumption of the Committee on Tuesday, Mr H. F. Parshall, who with Mr. Robert Hammond is acting as a joint consulting engineer to the promoters, was called and examined by Mr. Talbot. He said that he thought the station proposed to be erected was sufficient for the purposes. To attempt to combine the whole of the existing stations would cost something like 50 per cent. more than what their scheme was estimated to cost. He did not think that any scheme for linking up existing companies would solve the problem of the electric supply of London; he, however, considered that their scheme would. They would have turbines installed, and that would give them uniformity. Another advantage would be that by generating on such a large scale as was suggested economy would be effected. The average load factor of existing stations was 13 per cent. in the case of small stations, but taking bulk supply stations the load factor was 50 per cent. In their Bill they took the diversity factor of 1·66 per cent., which they considered was a reasonable one. In Chicago it was as high as 4 per cent., but allowing for loss in transmission, the average diversity factor was 2·8 per cent. The total cost of generation at present throughout the area was £1,388,000, but they estimated that they could supply the same quantity of energy for £748,000—a saving of £640,000. They estimated that there were at present 278,000 H.P. not supplied in the area covered by the Bill. The 278,000 H.P. equalled 208,000 KW. During the last seven years the rate of progress of the authorised distributors was 1,300 KW. Taking that as the basis, it would be reasonable to suppose that in the next 10 years there would be 120,000 KW. to be supplied. They estimated that in addition to that 90,000 KW. would represent the demands of the railway companies. Taking those figures, and making an allowance for power and other purposes,

they estimated that in 10 years' time the demand would be for 460,000 KW. They would install in the station at first, plant equal to 120,000 KW., which would be capable of producing 180,000 KW.—that was on a diversity factor of 1·66 per cent. The pressure at the station would be 15,000 volts. The site was practically the same as that in the L.C.C. Bill, and would allow of the station being extended if necessary. As regarded the distribution system, there would be five main arteries connected up with 14 main districts. They had divided the whole system up so that if one part should fail it would not interfere with other parts of the area. The scheme, so far as the distribution system was concerned, was the same as prepared for the L.C.C. To allow for the loss in transmission so as to sell 492 KW., they would have to generate 560 KW. The total capital expenditure of the local authorities at March 31st, 1907, was £8,197,910—on generation £3,133,818, and distribution £5,064,092. The companies had spent, all told, £13,353,238.

Cross-examined by MR. BALFOUR BROWNE, K.C., representing the North Metropolitan Electric Supply Co., WITNESS said that he could not see any objection why, if the promoters wanted to supply in the North Metropolitan area, they should not have the consent of that company. He was speaking as an engineer.

MR. BROWNE, K.C., proceeded to question Mr. Parshall at length as to whether he saw any objection to the insertion of the Kitson clause as put in the Administrative Bill. That clause provided that if the Board of Trade should say that the company should lay down mains in a certain district and they did not do so, they should clear out and leave the area to the existing company in the district. Witness said that personally he saw no objection to it.

WITNESS was cross-examined at length by MR. POLLOCK, K.C., on behalf of the Middlesex County Council, as to whether the 30 years allowed for the life of the cables was too great. Mr. Parshall said he thought that it was not.

MR. BUSHE, K.C., for the West End companies, cross-examined WITNESS. He admitted that the Kensington Co. was supplying power at a flat rate of 1d. per unit, and that was cheaper than what the promoters estimated. He knew that the area was an industrial one, and was already well supplied. He did not think that the alterations which had since been made in the Bill had affected the financial aspects. They had no assurances from companies that they would take a supply. The total range of their area was 451 square miles, and that was all dependent upon the one generating station at Barking.

In answer to SIR RALPH LITTLER, K.C., representing the City Corporation, WITNESS said that he was aware that the city was already crowded with mains. He did not see why the City, however, should have the powers of veto. He knew that there were two companies already supplying the City, and that the Corporation had the option of purchasing both or either of those companies.

MR. WEDDERBURN, K.C., for the Corporation of Croydon, cross-examined witness. He said he thought Croydon was a residential district. He could not say if they had anyone coming from Croydon to say that they would take the supply. According to their tables, Croydon would save £439 by scrapping, by combination they would save £538.

MR. ESSLEMONT, M.P., objected to counsel cross-examining witness on tables which had not been put in, and Mr. Wedderburn thereupon dropped the point.

MR. VESEY KNOX, K.C., representing Borough of Southwark, and the Urban Borough Councils of Chiswick, Beckenham, Hornsey and Finchley, asked witness whether it was not a fact that the cost of generation was decreasing. Witness said not so much in the small stations as in the larger stations, but there was an improvement. He admitted that they would not undertake business which was not profitable. He was not prepared to say whether they would supply in the Finchley district; he could not see why they should not.

MR. VESEY KNOX pressed witness as to whether it was not a fact that the tables put in by the promoters in the other House were misleading, inasmuch as, although they gave a figure representing the average price to the authorised distributor, it was really more in the case of outlying districts. WITNESS answered that he did not think they were intended to mislead, and he did not think they did.

MR. VESEY KNOX, K.C.: Do you, generally speaking, approve of competition in distribution?—He approved of the principle; it seemed to work well in the City. He knew of cases where there was a percentage of over 50 per cent. load factor for a general supply—for instance, the Yorkshire Co. The Yorkshire Power Co. had power to compete with others, but the local authorities had the absolute power of veto.

Mr. COURTHORPE MUNROE (for the St. Pancras and Shoreditch Borough Councils): Do you think that your Bill safeguards the interests of the local authorities?

WITNESS: I should say, with the Kitson Clause, it does.

By MR. MEYER (Battersea Borough Council): They thought they had a fair chance of supplying tube railways. He could not say whether they would supply a tramway company. He could not name any local authority who would take a supply, neither could he say if any company would do so.

(To be continued.)

Germany.—The Rheinisch-Westfalisches Electricitätswerke Gesellschaft, of Essen, reports a profit of £175,699 for the last financial year, an increase of £29,933. A dividend of 8 per cent. is being declared.

LEGAL.

WESTMINSTER ELECTRIC SUPPLY CORPORATION, LTD., *v.* L.C.C.

AN Arbitration Court was commenced in the Surveyors' Institute on Monday, before Mr. Symon, K.C., umpire, and Messrs. Young and Falconer, arbitrators in the case of the Westminster Electric Supply Corporation, Ltd., *v.* the L.C.C. In opening the case for the Westminster Electric Corporation, Mr. Balfour Browne, K.C., said that what the tribunal had to determine were certain questions arising under Sec. 11 of the London County Council Act of 1900, and more particularly sub-Secs. 6, 7 and 8 of the Act. The order under which the Corporation proceeded to supply electricity was passed in the year 1889, and under that they acquired a very valuable site in Millbank Street, which abutts upon the river. The new site in Horseferry Road, which was given them by the L.C.C., was to be deemed equivalent in all respects to the Corporation's present premises. The relative positions of those two sites was a matter of some importance. The Millbank Street premises were close to the river, and the water for condensing purposes was obtained there. They got their coal by barges to the works, and the barges were allowed to lie there absolutely as stores, while they were able to get away their ashes by water in the same way as they got the coal. These elements were, in the corporation's view exceedingly important. The business of the corporation had largely increased. In 1897, some time after the order, they were supplying 57,454 8-C.P. lamps, and that gradually went up, until in 1907, ten years afterwards, they were supplying 224,942. They had some important contracts with the Houses of Parliament and Buckingham Palace, and he believed an autumn session of Parliament was of some importance to the Corporation, as they consumed a large quantity of electricity. The building that the Corporation erected was built with a view to enlargement, and to build stores on the top. What had to be considered about the new site, was that there was no possibility of getting coal to the works or getting the ashes away from the works except by means of carting, and therefore space had to be provided at the new works for coal accommodation and for cartage. In 1899, after the corporation had enlarged their plant and pulled down certain houses that they were in possession of, the L.C.C. gave notice of their intention to carry out the Westminster improvement. The whole idea of Sec. 11 of the 1900 Bill was that firms were to be reinstated, and that there should be a continuous existence of the firm from the old to the new place. That meant that a site of equivalent value to the existing site and station, with similar capacity and similar capabilities of the existing station, had to be provided, or the L.C.C. would be required to pay a lump sum. The new site was not on the river, and in order to reinstate, the L.C.C. must give facilities or the Corporation must have a site which would make up the loss of that advantage. The L.C.C. would require to provide buildings where carts could stand and unload coal, otherwise it would not be an equivalent site, and they would not be reinstated. Since the Act of 1900 the Corporation had done as little permanent work at their premises as possible, in order not to take unnecessary money out of the pockets of the County Council. Certain temporary works had to be done, and these put the Corporation to considerable expense. In 1905 the Council offered them a site, but it did not satisfy his clients, and they went to arbitration. On the second day of the arbitration modifications were made in the site, and they came to an understanding. On May 5th, 1906, Mr. Young sent the Corporation a plan showing a subway from the river into the works, and if it had been carried out it would have been all they desired with regard to water for condensing purposes. The subway offer was ultimately withdrawn on November 12th, 1907, and an offer was subsequently made by the L.C.C. to lay down two pipes of 18 in. diameter. The Corporation had at their existing premises four pipes of 16 in. drawing water from the river. They had considered the L.C.C. offer, and the least they could accept for condensing purposes were four pipes of 20 in. each. His clients desired the pipes laid in a subway instead of in the streets as proposed. In answer to Mr. Symons, Mr. Brown said it would be beyond his province altogether to take anything but equal facilities or a lump sum for the loss of all facilities. He had not considered the idea of taking partial facilities, any difference being made up by a payment. The Corporation invited tenders for the erection of the generating station, the plans of which they had submitted to the L.C.C. who approved of them, and the work had now been put in hand. The Corporation put up a station that was, in some senses, more than a re-instatement. The sum that they claimed from the L.C.C. for that station was £73,809 6s. 3d., based on a seven-tenths calculation. One important matter in connection with the new site was that they had met with very great difficulties with regard to foundations. They had to go down 39 ft., as against 22 ft. at Millbank. They had entered into a contract for steam plant equal to 2,536 KW., and that cost £36,975. At Millbank the condensing plant was equal to 5,000 KW., a decrease of 2,464 KW., and they claimed compensation at the rate of £1·96 per KW.—£4,829. These two sums, therefore, amounted to £41,804. Other steam plant, not estimated for, had been put down at £53,839. For contingency charges and expenses of running the two concerns, &c., that had been estimated at £61,915. For motor-generating plant they would require a total sum of £23,130, which, together with the £61,915 for steam plant, made a total of £85,045. That was their claim for the plant of the capacity of the generating station. The plant that they were going to put into their station was new plant, and it would occupy less space than their existing plant would do. The total cost of the alterations of mains had been put

down at £34,015, this bringing up the total cost to £212,869. The cartage of coal, as compared with the coal brought by barge, would involve a total loss to the corporation of 2s. 6½d. per ton. Taking the average increase to be 380,000 units per annum, the coal required for steam plant was 11,988 tons on the average, and that at 2s. 6½d. extra, came to £14,073 per annum.

Mr. C. S. Peach, architect, in answer to the Hon. A. Lyttleton, said that the Corporation's building work had been designed by him in conjunction with Sir Alex. Kennedy. He stated that the total cost of Millbank works up to the passing of the 1900 Act, was £60,821 18s. 8d., which included rent and taxes. From the first the development and extension of the works were contemplated, and the building was accordingly made amply strong enough to be able to extend it upwards or sideways. Representations had been made from time to time to time by the Council, not to make additions to the premises, if they could avoid it. So far as they could they met the wishes of the Council, and all the work had been of a temporary character. Between 1889 and 1908, temporary alterations had cost £18,000. Mr. Peach afterwards compared the existing buildings with the accommodation at Horseferry. The tender for the erection of the new building amounted to £89,305.

Mr. C. S. Peach, architect, was further examined on Tuesday by Mr. Lyttleton, on the plans of the old and new buildings. Witness stated that the cost of temporary works at Millbank amounted to £16,000, and he was satisfied that the Corporation could have carried out permanent improvements on the top part of their buildings at a cost of £10,000. As both the corporation and the L.C.C. had received equal advantages through these improvements, he put the claim down at £3,000. He did not know of any reason why the subway proposed by the Council, and ultimately withdrawn, should not have been carried out. He thought, however, that the work would not be very easily done.

Sir Edward Clark, for the L.C.C., closely cross-examined Mr. Peach upon the sums he estimated for proposed work, and how he brought out his calculations. Witness stated that he based his calculations of the new building on the capacity of the old one, and not on the capacity of the output of electrical units. He never took into consideration the question of output. His reading of the Act was that the new building had to provide equal facilities to the old one. The building had no output, it only had capacity. By having a new building and new machinery, which would take up less space, he thought that the corporation ought to have the advantages which accrued in space. In answer to Mr. Symons, witness said that if the Corporation did not get water, but got compensation instead, they would not require condensing plant and would introduce other machinery. The building was designed for condensing plant, and if that machinery was not introduced, there would possibly be a difference in the cost and in the shape of the new building.

Sir Alex. Kennedy, in giving his reasons why he rejected the offer of the L.C.C. of two 21-in. pipes, said that the new station was a very considerable distance from the river, and as the water had to be drawn from the river by suction, he therefore required a much larger area of pipe for suction than he did for discharge. Another reason was, he was to employ plant which would use more condensing water per pound of steam. He thought he would require about 540,000 gallons of water per hour.

Sir Alex. Clark asked witness if three 24-in. pipes would suit his purpose, and Sir Alex. Kennedy replied that he thought they probably would.

It was afterwards agreed that Sir Alex. Kennedy and the engineer of the L.C.C. should meet and discuss the question of the number of pipes.

The Court adjourned until about the middle of November.

THE MANCHESTER EXHIBITION: WHAT IT IS DOING.

[Views of Exhibitors.]

At the time of writing there are still several days' further run before the Exhibition closes its doors. While the event has been in progress, with the spirits and energy of the exhibitor unrestrained, with hands and tongue busily engaged explaining the construction and advantages of his apparatus or plant, and taking note of inquiries and orders, with the visits of electrical engineers and employés from practically all departments of supply and industry, and the ever and again meeting of old friends, it was easy to feel that things were going along swimmingly, and that there was no doubt about the ultimate issue. Therefore it is not yet possible to form a definite opinion concerning the exact amount of benefit that has come, or will come, directly or indirectly as a result of the Exhibition, though with Saturday, the closing day, so near, no doubt exhibitors are beginning to do what they can to weigh up the advantages, and also the disadvantages, if any of the latter there be.

After hearing, as we have become accustomed so frequently of late, a tale of woe concerning the unhappy position of the electrical industry in this country, it is quite refreshing to pass down the Rusholme gangways, and hear from one exhibitor and another a most hopeful statement concerning their experience, so far as things have gone, during the month of October. It may be that here and there one comes across an exhibitor who admits more or less reluctantly that he has had inquiries but no orders, or perhaps another who has secured orders but not for the lines he most desired to sell, but mostly, we believe, the result has been good orders and numerous inquiries too, from the right class of people, and for the classes of manufactures that in advance they had believed to be the most suitable things to push in Manchester and Lancashire.

It is, however, not our intention to exhaustively sum up the effects of the show in this week's issue—that will follow next week. We content ourselves here with quoting a few of the opinions that have been received from exhibitors in response to a series of questions which we put to them on the subject. These questions were as follows :—

1. Has the Exhibition been as great a success as you anticipated ?
2. In what way has it been successful in your own case ?
3. What classes of inquiries and orders have you been receiving ?
4. Do you think that the good effect upon the electrical trade will continue after the Exhibition has closed ?

A firm of *High-speed Steam Engine Makers* considers that the Exhibition has been a decided success. It enabled them to show their latest productions to a very large number of important electrical and other engineers who have visited the Exhibition. A great many inquiries for steam engines were received as a result of their exhibit.

A firm of *Boiler and Steam Plant* suppliers answer the first question, "Yes." They have been brought into personal contact with a large number of persons interested in power driving, and have received inquiries and orders for steam boilers, engines and superheaters. The fourth question they answer in the affirmative.

"*Lamp Makers*" are more than gratified at the success of the Exhibition, that success having been even greater than had been anticipated. This success has come because their specialities have been brought before hundreds of the best and largest buyers in the country to whom it would otherwise have been difficult to show various items individually, especially the running of new metal lamps and carbon lamp specialities. Received large inquiries, some good orders, and numerous small sample orders. The advantages of electric light over gas, owing to the introduction of the new lamps, were brought before the notice of general users. The interest shown by the general public in the Exhibition has been phenomenal, and cannot but benefit the electrical trade in the future.

"*Accessories Suppliers*" say that the Exhibition has been a great success, and with the experience gained thereat, the management and exhibitors alike should have no difficulty in making the next show a far greater success. The event has been useful as a general advertisement, bringing more inquiries and orders and new customers. Business was done in all their gear for the electrical and engineering trades. The effect upon the trade must continue to be good if individual exhibitors follow the Exhibition with a strenuous order-getting campaign.

"*Conduit Suppliers*" are perfectly satisfied with the result, having had some hundreds of inquiries and many orders. The answer to (4) must depend on many things, but generally the good effect should continue.

"*Gas Engines*" have received a number of satisfactory inquiries and done "just a little" business.

"*Suppliers of Dynamos, Motors, Switchgear, Meters, Lamps, &c.*," answer (1) "Yes." They have had a large number of original inquiries, have made direct sales to new customers, and have demonstrated their goods to possible customers. Visitors were receptive. Inquiries and orders were received for the whole range of the firm's goods, both exhibited and non-exhibited manufactures. The educational value upon the minds of the large crowds coming into the Hall on free ticket must be effective

for some time to come. They believe that many held-up works will now be proceeded with and that they will bring others along.

"*Switchgear Manufacturers.*" In reply to (1), "Yes." Have been able to introduce their goods to new consumers and possible buyers. Inquiries and orders for switchgear. Effect of exhibition must be good.

"*Machine Tools*" say great success, but might have been greater if trade generally had not been abnormally bad. The Exhibition has stirred up numerous good inquiries for, and a widespread interest and belief in, the permanence of high-speed planers. Home and foreign orders and inquiries for self-contained machines driven by motors. Future effect on electrical and machine tool trade must be good.

"*Lamps and Batteries*" answer Yes to (1). They have received orders and inquiries for fire-alarms, accumulators, lamps and lamp-holders, and think that lasting good effect will be experienced.

"*Battery-Maker.*" Great success. Good as an advertisement. Orders and inquiries for lighting sets. Effect will be good.

"*Accumulator.*" Inquiries for batteries for private installations.

"*Heavy Apparatus Makers*" say that the results have far exceeded their expectations. As a large proportion of their apparatus is not portable, they have had an excellent opportunity of demonstrating it before likely purchasers. Inquiries and orders have been received from collieries, mills, and the trade generally. The after-effect of the Exhibition must be good.

"*Power Installation Contractors*" say "Yes" in reply to (1), the Exhibition having been useful in their case as an advertisement, promoting varied inquiries and orders, including many of the kind that they desire. The good effect upon the trade will continue.

"*Everything Electrical*" say that they have experienced much greater success than they anticipated, having secured orders and good inquiries from new directions, including both the trade and the public. They consider that the Exhibition will stimulate the general trade. Great interest in metal-filament lamps has been aroused.

"*Engine-Makers*" answer (1) in the affirmative. The event has been successful chiefly as an advertising medium for one of their leading specialities. Many *bonâ fide* inquiries have been received, but so far as can be traced, no definite orders. The after-effect must be good.

"*Cautious Correspondents*" say that if the success of the Exhibition can be gauged by the number of visitors who called at their stand, their expectations have been fully realised, but they cannot express the success in the equivalent of £ s. d. They received inquiries from the electrical trade proper, but the orders were incommensurate with the inquiries. As to the after-effect upon the trade, "this question is most difficult to answer. New accounts opened may prove profitable in the future, but we do not anticipate any lasting effect upon the electrical trade generally, neither from this nor from any future exhibition."

Wireless Cluster Fittings.—The Benjamin Electric, Ltd., whose works are located at 1a, Rosebery Avenue, London, E.C., have brought out a line of cluster fittings and lighting specialities of a wide range of types and sizes adapting them for any purpose. The distinguishing feature of these fittings is the "wireless" principle which eliminates all separate wiring connections to the lampholders. The wireless cluster fitting consists primarily of a body shell with detachable back for supporting the cluster to a stem, or attached direct to surface. Complete lampholders of a special design are permanently attached to the body shell. These holders are connected internally by connecting conductor rings carrying binding screws for attaching leads from the "live" circuit. The artistic possibilities of the fittings when combined with suitable glassware, are taken advantage of in a type known as "Holophane Arcs," consisting of cluster body with from three to six holders, supported from the ceiling by either brass stem or chain, and equipped with Holophane prismatic reflectors and shades; opal reflectors and shades may be substituted if desired. We understand that Mr. Chas. F. Trippe, 36, Brook Street, Holborn, London, E.C., is sole agent for the United Kingdom for the Benjamin devices, and he has fitted up a show-room at his offices displaying a complete line of the various types of cluster fittings installed as in actual use.

INSTITUTION OF ELECTRICAL ENGINEERS' ANNUAL DINNER.

On Thursday last week the annual dinner of the Institution of Electrical Engineers took place at the Hotel Cecil, Mr. W. M. Mordey, the president, in the chair. The occasion was marked by the presence of many of the delegates to the International Conference on Units and the International Electrotechnical Commission, and many other distinguished guests.

After the loyal toasts, to which was added "The Rulers of all other Countries represented by the Guests," Mr. Haldane proposed "Science and Industries," a cosmopolitan toast. He classed Prof. J. J. Thomson with such great men as Weber and Gauss, and pointed out the revolution in mathematical science which was in progress. Formerly the motion of a point in space was the standard for testing mathematical ability; now the conception of number had been found to be quite obscure, and it had become necessary to introduce irrationals to complete the domain of number. Progress was continuous; higher and more general conceptions were continually sought, and they could not stand still. There was no real rivalry in the search for truth; all rejoiced when anyone threw new light upon a difficult problem.

Prof. J. J. Thomson, in reply, referred to the loss to the world of Lord Kelvin; while others emitted bright lines, Lord Kelvin's was a continuous spectrum covering the whole range of science and practice. Electrical science was advancing by leaps and bounds, and was destined to minister to all their comforts and necessities. Public appreciation of science was due to its applications by engineers, though he would not think of justifying science by its practical applications. Extraordinary facilities were now offered by engineering to research work, contrasting with the difficulties under which it was formerly carried on; pure science, on the other hand, had conferred immense benefits on engineering. Referring to the discovery of radium, which in its dissolution evolved energy, Prof. Thomson speculated upon the possibility in the future of "killing" ordinary matter and making it disgorge vast quantities of energy.

Mr. George Franklin also replied, on behalf of industries, and said that of all His Majesty's Ministers there was none who had done so much as Mr. Haldane for science, and for its application to industry; the modern Universities owed an everlasting debt of gratitude to him for upholding their cause. The surest basis for the advancement of trade was the scientific basis.

Lord Alverstone proposed "The Institution of Electrical Engineers," of which he was a member, and referred to the fact that it was the jubilee year of the Atlantic cable; he recalled a visit to Glass Elliott's works, when he was 15 years old, and saw the cable being coiled down into the *Agamemnon*. He eulogised the pioneers of those days—Sir Wm. Thomson, C. W. Siemens, Sir F. Abel, Sir Chas. Bright, Hopkinson, Scudamore, and others—and congratulated the Institution upon its splendid progress; he had heard with the greatest satisfaction that it was about to establish itself on one of the best sites, and in one of the most commodious buildings in London.

The President replied, referring to his membership of 25 years, and said that the Institution was now the second great engineering institution in the world—second only to the Institution of Civil Engineers. He offered a most hearty welcome to the foreign delegates, in the name of the 6,048 members, and remarked that Latimer Clark and Sir Chas. Bright in 1861 read a remarkable paper on the necessity for formulating electrical standards to meet the requirements of practical telegraphists. The Atlantic cable was laid under inconceivable difficulties, on account of the lack of definite units. A committee of the British Association was formed to deal with the question, including Sir Wm. Thomson, Sir Chas. Bright, Latimer Clark, Sir Wm. Siemens, Carey Foster, Clerk Maxwell, Joule, Cromwell Varley and Fleeming Jenkin, five of whom subsequently became Presidents of the I.E.E., which was founded in 1871. The committee reported again and again, and laid the foundation of the existing system of units. Prof. Carey Foster was the only survivor, and had taken part in the deliberations of the past fortnight, continuing the work begun in 1861. The names adopted for the units stamped them as international from the start. They should not regard with sadness the death of Lord Kelvin, but rather rejoice that this country had produced him, worthy to follow in the footsteps of Clerk Maxwell and Faraday, and that throughout his long life he had enjoyed the full exercise of his great gifts. He was thrice president of the Institution, and they had founded in his memory a Kelvin lectureship; Prof. S. P. Thompson, who delivered the first lecture, was engaged upon a biography of Lord Kelvin.

Regarding the Atlantic Cable, he wanted to claim for Sir Charles Bright the credit that was his due; Lord Kelvin had very fully acknowledged their debt to the skill and courage of Bright. The first cable was killed, by no fault of Kelvin or Bright, but in eight years, thanks to their labours, success was attained. Lord Kelvin's work was done so well that no great advance had been made in telegraphy since his day, until quite recently Brown, with knowledge acquired in the dynamo room, had been able to increase the speed of signalling by 30 per cent. They owed a debt of gratitude to the Institution of Civil Engineers, none the less for the fact that they were about to enter their new home, where they hoped in turn to extend hospitality to others.

Prof. S. P. Thompson proposed "The Delegates," and humorously commented on the vast powers of an International Congress; π had been defined in Deuteronomy as 3, while an American State

had passed a law that it should be 3½. The Conference had decided that the ohm had two values—10^9 C.G.S., and 106·300 cm. of mercury of given mass; it had thereby settled by law the specific resistance of mercury, the density of water, and hence the mass of 1 cb. cm. of water—far-reaching and unexpected results!

Dr. E. Warburg replied, referring to the value of uniformity in saving time and money. An international community of interests was one of the best means of establishing good relations between different countries, and they were indebted to their English hosts for their kindly hospitality, tending towards that end.

M. P. Boucherot also replied, and Dr. S. W. Stratton, who regarded as the most valuable result of the Conference the establishment of a permanent electrical commission.

Prof. Kapp proposed "Our Guests," referring to the many distinguished visitors, and to the function of electrical engineering to assist without rivalry all other branches of engineering.

Mr. R. A. Robinson, chairman of the L.C.C., replied, pointing to the deep interest of all, especially Londoners, in the progress of electrical science. The L.C.C. had the largest municipal generating station in the world, and would use half a million units a day when it was completed. The Council, however, did not wish to enter into rivalry with private enterprise; let the engineers take the risk, and supply London at the lowest possible price.

After the dinner, which was accompanied with a programme of music by the Imperial Orchestra, the company adjourned to another room for the usual chat, though the lateness of the hour curtailed the time available for this purpose. There were present nearly 400 members and guests.

BUSINESS NOTES.

Catalogues.—MESSRS. A. ALLAN & SON, New York.—Two very attractively got-up pamphlets describing the Allan red anti-friction metal and its practical applications.

MESSRS. A. EMANUEL & SONS, LTD., George Street, Manchester Square, W.—Fourth edition of their catalogue (18 pages) of fancy silk, glass, enamelled iron, and other shades for electric light.

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—New edition of their catalogue of Simplex electric heating appliances, including both luminous radiators, and heaters working on the strip principle; the radiators cover a wide range of prices, and many others besides those listed can be seen at the company's London showrooms in Charing Cross Road.

MESSRS. JOHNSON & PHILLIPS, LTD., Charlton.—New price list dealing with a number of styles and types of porcelain insulators, bolts and fittings. Also a list which deals with Paterson's bitumen damp-proof sheeting. Of both these lines of manufacture the firm carry large stocks.

MR. G. BRAULIK, Upper Thames Street, E.C.—Leaflet describing the type B.R. "Eclipse" D.C. watt-hour meter for two or three-wire circuits up to 30 amperes 600 volts.

MESSRS. LUDW. LOEWE & CO., LTD., London, E.C.—New catalogue (24 pages), in which they illustrate and describe several new types of the "D.W.F." patent ball bearings.

MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., 6, Bath Street, City Road, E.C.—Small booklet containing illustrations and particulars of the various types of "Tantalum" lamps. A few reproductions of photographs of illustrations showing premises lighted with these lamps are included. Copies of the booklet will be forwarded on application.

New Zealand.—*Australasian Hardware and Machinery*, of September 1st, states that electrical machinery to the value of £75,000 will be required to complete the Waipori power scheme.

Liquidation. — COMMERCIAL ELECTRO-CHEMICAL ANALYSIS CO., LTD.—A meeting is to be held at 10, Pancras Lane, E.C., on November 30th, to hear an account of the winding up.

Installation Contracts.—MESSRS. MORRISON AND ROEBUCK, of Blackpool, have received the following contracts:—

Accrington.—Electric lighting and ventilating at the New Hippodrome.
Blackpool.—Electric lighting and ventilating at the Theatre Royal.
Leigh and Bedford.—Electric lighting and ventilating at the New Hippodrome.

Meeting of Creditors.—THE ELECTRICAL INSTRUMENTS MANUFACTURERS, LTD., Freezywater, Waltham Cross, Hertfordshire.—The adjourned first meeting of the creditors herein was held on Tuesday last, at 14, Bedford Row, W.C., at which the validity of the debentures issued by the company was discussed, and eventually there was further discussion as to whether the estate should be left with the Official Receiver or whether a private liquidator should be appointed. Finally, it was resolved that no application should be made to the Court by the Official Receiver, for an official liquidator other than himself. On the question of a committee it was decided that none should be appointed. The statement of accounts showed liabilities amounting to £1,015, to meet which there were assets estimated to realise £75, this amount being entirely absorbed by preference claims, while as regards contributories there was a total deficiency of £3,022. It appears that the company was incorporated on October 19th, 1905, to carry on business as electrical engineers, contractors, &c., and to enter into an agreement. The business was carried on at the above address. On January 31st, 1907, an agreement was entered into between Thomas Ward (the vendor), H. G. Matthews (the trustee) and the company. The vendor was the owner of the business of an electrical engineer with goodwill, plant, machinery, &c. By an agreement dated November 20th, 1905, between the vendor and the trustee, the vendor agreed to sell to the trustee on behalf of the company all the said assets, and such agreement not being stamped, it was agreed between the parties that it was to be considered cancelled, and the vendor agreed to assign to the company all goodwill and assets in connection with the said business. The consideration was: (1) £2,000, by allotment to vendor of 1,000 fully-paid ordinary shares, and by allotment to Frank Huth of 1,000 fully-paid ordinary shares; (2) the appointment of the vendor as managing director for five years as from the date of its incorporation at an annual salary of £100, exclusive of all expenses and disbursements usually allowed to a managing director. This agreement was filed on February 27th, 1907. The directors of the company were:—Thomas Ward, Walter Bugg, and Edward William Davies. The nominal capital of the company was £2,000 divided into 5,000 shares of £1 each, which had not been increased or reduced since its formation. The total amount issued for cash was £7, and £2,000 was issued as fully paid. On March 24th, 1906, the company issued debentures up to £500 covering all the assets. A motion was pending in the High Court at the date of the winding-up order for the appointment of a receiver on behalf of the debenture-holders, and at the hearing on September 29th, 1908, the plaintiff's solicitors did not attend, and the Master ordered it to stand over with liberty to restore. The following books of account are stated to have been kept:—Cash book, sales ledger, day book, share ledger, register of members, register of directors, register of transfers, minute book, scrip book, register of mortgages, petty cash book and letter books. Mr. Thomas Ward, the managing director of the company, states that the cause of the company's failure is want of capital, and that it has not been in a position to discharge its liabilities in full since the commencement. In the whole of the circumstances the Official Receiver is of opinion that it is desirable to make further inquiry as regards the manner of conducting the business of the company. The following are creditors:—

Board of Trade Journal, London	£35
Bugg, Miss Amy	14
Ward, T., Enfield Wash	315
Gordon & Gotch, London	50
Bray, T., London	133

Private Meeting.—FRANK ALLEN, electrician, &c., Church Green West, Redditch.—A meeting of the creditors of the above was held a few days ago, when a statement of affairs, prepared by Mr. Chas. Harrison, C.A., was presented. According to this the liabilities amounted to £444, of which £104 was due to cash creditors. Mrs. Allen, the wife of the debtor, was scheduled as a cash creditor for £68. There was one fully secured creditor for £100, who held a mortgage on free-wiring contracts. The mortagee held the agreements between the debtor and the Redditch Urban District Council, and had taken a formal mortgage, of which he had given the necessary notices. The security thus held was valued at £200. The mortagee also held a policy on the debtor's life for £250, effected in favour of his wife. The assets were estimated to realise £302, a deficiency of £142 being thus disclosed. The assets were made up as follows:—Book debts £254, expected to produce £144, household furniture £25, surplus on free-wiring contract £100, and cash at bank £33. It was reported that the debtor started in business for himself some years ago, with a capital of about £80, money which he had saved, and he had since borrowed various sums from his wife amounting to £68. The landlord had let the debtor go for some time without paying his rent, but last month he distrained for 18 months' rent. The debtor had sold his tools, stock-in-trade, &c., to Messrs. Cranmore, Simmonds & Co., Ltd., for £125, and had entered their employ as a foreman. It was now suggested by this firm that they should take over the assets, and pay the creditors a composition of 7s. 6d. in the £. The matter was fully discussed, and eventually it was resolved that Mr. J. D. Kerr, acting for Messrs. Rowe Bros., should make an investigation and report to the creditors as to the acceptance of the offer.

Bankruptcy Proceedings. — THOMAS WARD, late director of the Electrical Instrument Manufacturers, Ltd., 22, Totteridge Road, Enfield Wash, Middlesex, late Freezywater, Waltham Cross, Herts. The receiving order herein was made on a creditor's petition, the act of bankruptcy being the debtor's non-compliance with the requirements of a bankruptcy notice. The accounts filed show unsecured liabilities of £1,162, and no assets. The debtor states that he has been managing director of two companies, both of which are now in liquidation. He ascribes his failure to becoming guarantor for a limited company's liabilities. At the date of the receiving order three creditors had obtained judgment against the debtor. His daughter claims the household furniture. The following are creditors:—

Bugg, Walter, Cheshunt	£677
Archer, Geo., Waltham Cross	223
Padgham, Chas., Waltham Cross	47
Gardiner, A. J., Tunbridge Wells	51
Langhams, —, London	22
De Hamel, London	108

Preference creditors, £22.

GEORGE HARRY SMITH, electrical engineer, 15, Ashley Road, Altrincham.—November 7th is the last day for the receipt of proofs by Mr. J. G. Gibson, trustee, Byrom Street, Manchester.

The "Write-Up."—Writing recently in an American paper, Mr. Walter B. Snow says: "In the best journals the so-called write-up has been placed upon a relatively high plane. This has been made possible by such absolute independence of the editorial and the advertising departments that articles of merit may be

described regardless of the fact that their manufacturers are not advertisers in the particular paper. This condition opens the way for much more legitimate technical publicity than is secured by the average advertiser. If he will but understand the editor's attitude, he will see that description of his particular product or system is withheld or given solely upon the basis of its novelty or its relation to the field covered by the given journal. If he has something really new it will be described. If he has acquired the art of making news out of the facts that others neglect, he may frequently find his name in print, with at least indirect benefit to his business."

Trade Announcements.—Messrs. H. G. Mayer and Co. are circularising the trade, stating that they have secured the sole agency of the "Plania" Carbon Works, at Ratibor and Berlin, for all kinds of arc lamp carbons, carbon brushes and electrolytical blocks.

Mr. Robert Crust, contractor for electric lighting, telephones and bells, has opened premises at 14, Booth Street, Bradford, Yorks.

Mr. C. Conradty has purchased the business of the Aktiebolaget Bronskol Co., of Stockholm, and is now in a position to supply "Bronskol brushes" for dynamos promptly. The sole agents for Mr. C. Conradty for this country and the Colonies are the Sloan Electrical Co., Ltd., of 15, Fore Street Avenue, London, E.C., to whom all communications should be addressed.

The Edison & Swan United Electric Light Co., Ltd., announce that they are now in a position to deliver standard ranges and voltages of their auto-transformers from stock. These are all made throughout at their Ponder's End works.

Book Notices.—*Glasgow Technical College Magazine.*—Following the example of other colleges, the Glasgow and West of Scotland College has started a magazine; the first number embraces 28 pages, not counting advertisements—of which there are not a few—and presents a very creditable appearance. The editor is Mr. Jas. Cuthill, convener of the Organising Committee of the Evening Students' Representative Committee "which will be inaugurated for the first time this session" (we hope that it will never need reinaugurating). Skits, poems, reports, allegories and jokes abound in this number, which even contains the result of a limerick competition. We wish it the success it deserves.

"*Mechanical World*" *Electrical Pocket-Book for* 1909. Manchester: Emmott & Co. Price 6d. net.—This book is now in its second year, and has been considerably extended, a large number of new sections having been added. It has the advantage of youth, in that it is not overloaded with obsolete matter; each section is brief and concise, and the treatment appears to be clear and correct. In the section on units we must take exception to the repeated use of the word potential to denote difference of potential, but a cursory examination has not disclosed many errors. The diameter of the tungsten filament is given as 100·055 mm. on page 142, an obvious slip. A diary is provided at the end of the book.

"Journal of the Institution of Electrical Engineers. October, 1908. Vol. XLI. No. 192. London: E. & F. N. Spon, Ltd. Price 5s.

"American Institute of Architects; Quarterly Bulletin." July, 1908; Vol. IX., No. 2. Washington: The Institute.

LIGHTING and POWER NOTES.

Accrington.—The Council's electrical undertaking is growing rapidly; the new length of tramway in Haslingden means an addition to the power generated, and Church and Clayton-le-Moors, two neighbouring towns, have arranged to take supplies under the provisional order.

Aston Manor.—The T.C. has entered into an agreement to supply energy to the pumping station at Saltley for the Birmingham, Tame and Rea District Drainage Board.

Barking.—Messrs. Hawtayne & Zeden have accepted the Council's offer of £10 10s. in settlement of their account for commission in respect of the inclusion of the electric lighting feeder cable in the light railways specification. An offer from the British Fuel Economiser and Smoke Preventer Co. to install their apparatus at the generating station, for a month's trial, free of expense, is being considered. The engineer is to prepare an amended scale of charges for the use of electricity for power purposes.

Canada.—Ottawa.—A desperate effort is being made by the corporate interests of Ontario to discredit the Government's power policy in the eyes of the farmers, through whose land the trunk transmission lines pass through from the Falls. Under the present arrangement the farmers are giving a free right of way across their land for the Government's transmission lines. The farmers are fully cognisant of the benefit to the province of cheap hydro-electric power, and are co-operating with the Government in establishing the scheme. The corporate interests, however, through their newspaper organs and otherwise, are carrying on a campaign with a view to frightening the farmers and preventing the line from passing across their farms. The corporate interests are, of course, the owners of existing power plants throughout the province, who are afraid lest the Government's power policy will reduce their profits. Ontario has no coal; the nearest coalfield is in Pennsylvania, whence she draws what she requires, the cost being some $7·50 per ton. She, however, has numerous water-powers all over the province, and the object of the Government is to utilise these water powers, now going to waste, for power purposes. Niagara is, of course, the greatest, but there are hundreds of waterfalls within the province large enough for local industrial purposes.

Cardiff.—The Electric Lighting Committee of the Corporation, on the suggestion of Mr. Arthur Ellis, the electrical engineer, has decided to apply to the L.G.B. for permission to borrow £25,000 for extensions of plant at Roath and Canton power stations consequent upon the supply of Hill's Dry Dock and other large consumers next year.

China.—Advices to hand from Mr. Aldridge, the engineer, show that considerable progress is being made by the Shanghai municipal electricity department. A complete coal and ash handling plant and a new Allen surface condensing plant have been added at the power station, and Berry automatic control gear is being installed in the sub-stations. Work is also in progress on a new Willans 800-kw. turbo-generator. Some 200 public arc being supplied, and 100 60-c.p. tungsten lamps are being placed in certain roads. Exclusive of street lighting, 160,000 equivalent 8-c.p. lamps are connected, including some 500 h.p. of motors. Since February last the department has been supplying the local tramways.

Cleethorpes.—The U.D.C. has decided to prevent the lapse of the E.L. order by laying cables from the generating station (which is only used for supplying power to the tramways) within a reduced area.

Clitheroe.—Employers of labour and business people have been circularised by the T.C. with regard to the provision of electricity in the town. The Council four years ago obtained powers for supplying electricity within the borough, but so far no scheme has been launched on the strength of these powers; and as they are about to lapse, the Corporation is testing the feeling of the inhabitants on the matter.

Coventry.—The question of placing the gas and electricity departments under common management has arisen since the acceptance of Mr. Jeckell's resignation; it is stated that the appointment of a manager to the electricity department has been deferred for six months with a view to giving this matter consideration.

Croydon.—The Electricity Committee, in view of the desirability of having an inquiry office and store in the centre of the town, has secured No. 3, Park Lane, close to George Street, on a fours years' agreement. The net cost to the department will be about £200 a year.

Dudley.—The annual accounts of the electrical undertaking of the Corporation show an increase in the amount received from private consumers of from £10,106 to £11,207, and a net profit of £336, as compared with £67 17s.

Dundee.—The delay in the completion of the new generating station at Carolina Port is engaging the attention of the Electricity Committee. The generating plant is ready for installation, but it cannot be installed on account of the backward state of the building operations. Business which has had to be refused, and for which arrangements had been made, is stated to represent revenue amounting to £1,500 per annum. Nor does this represent the pecuniary loss caused by the delay, as interest charges are mounting up. Messrs. Willans & Robinson, the contractors for the turbo-alternators and other plant in connection therewith, some time ago were paid an instalment of £10,000 for plant. Other contractors are making similar claims for finished work, of which the engineer, through no fault of his own, is unable to take delivery. The existing station at Dudhope Crescent is overloaded to an extent that involves the possibility of a serious breakdown. Last winter the margin was reached, but this winter it will be exceeded by 200 kw.

Egham.—The Electric Light Co. is preparing a scheme by which customers can have their houses wired, and, at a rental of 2s. 6d. per lamp per quarter, may have the electric light supplied from dusk to daylight without any further charge. The scheme will doubtless lead to a fuller appreciation of the advantages to be gained by the residents in dealing with the company.

Falkirk.—Main Street, Bainsford, is to have the advantage of electric light, the inhabitants having complained of the inadequacy of the present system of gas lighting.

Govan.—The fifth annual report of this undertaking, for the year ended May last, shows a profit on the year of £629—a figure obtained despite increases in fuel cost and rates, and general trade depression. Some 2,650,000 units were generated and 2,161,000 units sold, including 1,163,000 for power purposes.

Grimsby.—As a result of a conference with the Admiralty, on the wireless telegraph station at Humberstone, it has been recommended that the work of laying cables to the station should be carried out.

Guildford.—There was an interesting demonstration at Guildford on Saturday evening, when the arc lighting scheme of the Upper High Street came into operation for the first time. The new lighting is considered a great success.

Herne Bay.—The U.D.C. on October 21st passed a resolution to apply to the B. of T. for a prov. order for electric lighting.

Hythe.—The Folkestone Electricity Co. is about to spend £1,800 in Hythe in laying new cables and improving the existing services.

Liverpool.—The considerable criticism which has arisen in the T.C. on the matter of the Lister Drive turbo-generating plant, supplied by the Westinghouse Co., and in connection with which a lengthy report was recently submitted by Mr. A. Bromley Holmes, the Council's consulting engineer, has terminated in an exchange of correspondence between the latter gentleman and Alderman Sir William Bowring. From this it appears that Mr. Holmes takes exception to statements made by Sir Wm. Bowring in the Council meeting of October 7th, which he considers reflect seriously on his professional conduct. These statements Sir William refuses to withdraw, contending that his criticism concerns the Committee as a whole, and Mr. Holmes has consequently sought legal advice on the matter, in the meantime making the correspondence public.

Having regard to the large amount of electricity now consumed for lighting purposes under the various committees of the Corporation, it has been suggested that the T.C. should appoint an electrician to periodically examine and report on the installations and fittings.

London.—Marylebone.—As a result of arbitration in regard to the fees claimed by Mr. Arthur Wright, consulting engineer, it has been agreed that some £342 is due to him from the Electricity Supply Committee and £85 from the Lighting Committee. The Council is to defray the cost of the arbitration.

Mexico.—The available motive power which the River Santiago can supply to the city of Guadalajara is stated to be equal to 200,000 H.P. At present four concessions exist, appropriating nominally 115,400 H.P., but in practice only 100,000 H.P. would be used. All these concessions have been granted for the utilisation of the waters of the Santiago between Lake Chapala and San Cristobal; in this part of its course, a distance of 90 km., the river forms a semi-circle around the city. In the part not yet subject to concessions, the river may be used for the production of about 100,000 H.P. The city is thus, from the point of view of the supply of electrical energy, in a most favoured position. A joint stock society has just been formed at Guadalajara, styled the Compania de Luz y Fuerza de Atotonilco, with a capital of $50,000, whose object is the installation of a central station for the supply of light and power to the town of Atotonilco and the plantations and factories in its neighbourhood.

Oswaldtwistle.—The District Council is to be asked to permit the Accrington Corporation to supply energy to Moscow Mill and the Artillery Riding and Gun Shed.

Perth.—Messrs. P. & P. Campbell, the well-known dyers, intend introducing electric lighting in their works. Should the Corporation grant a cheap enough rate, the firm will take its supply from the town, but failing this Messrs. Campbell are to have an installation of their own.

Redruth.—The Union Assessment Committee has increased the assessment of the undertaking at Camborne of the Urban Electric Supply Co. from £195 to £1,287.

Stourbridge.—The General Purposes Committee of the U.D.C. has been considering a proposal by the Shropshire, Worcestershire and Staffordshire Power Co. and the Midland Electric Corporation for Power Distribution for the cancellation of the existing prov. order under the Electric Lighting Acts, and the granting of a new Order on the application of Stourbridge Council. The companies concerned asked for a clause in the new Order repealing the Stourbridge Electric Lighting Order of 1899, and also for the variation of certain clauses contained in the deed of transfer from the Stourbridge Council to the Electric Power Co., dated December 31st, 1906. The General Purposes Committee has, however, come to the conclusion that the proposals of the companies should not be expedited.

Walthamstow.—It has been decided to lease a shop for three years as a showroom for the electricity undertaking. A charge of £2 2s. per lamp is to be made to arc lamp consumers, such charge to cover supply of energy for 800 hours' burning per annum, and maintenance, all hours of burning above 800 per annum is to be charged at 2d. per lamp per hour.

Ware.—At a meeting of the U.D.C. on October 21st, a letter was read from the B. of T. stating that the E.L. Order, 1905, had been revoked.

Watford.—A L.G.B. inquiry was held last week relative to the Council's application to borrow £1,830 for extensions of the electricity undertaking. The Council intends to take in hand the improvement of street lighting generally. A start is to be made by substituting metal filament for carbon lamps in 38 street lamps.

West Ham.—Negotiations have been in progress between the Electricity Committee and the Charing Cross Supply Co. for an interchange of supply between the Bow and Canning Town power stations. The electrical engineer points out the great advantage that the Council will obtain by having 16,000 KW. to draw upon from Bow, and the company, similarly, by having 12,000 KW. at Canning Town to draw on. The engineer regards the greater reliability of supply of more importance than the other advantages. The method of payment for the interchanged current presents no difficulties because it is proposed to base it entirely on the working costs of each party, the intention being that neither party supplying current shall make any profit on the actual exchange. A schedule will further vary the price, according to the time of day energy is taken. The two stations are about 2¼ miles apart, and the systems can be connected without any running machinery. The engineer is to put a draft scheme shortly before the Committee, which has approved of the principle of the interchange, and has instructed him to continue his negotiations with a view to an agreement being entered into. The electrical engineer reported the receipt of an advantageous offer from a firm of conveyor makers, who, for the purpose of getting a new type of conveyor into use in a large power house, will put in two conveyors such as are required by West Ham for £650, the ordinary price of which would be quite £1,000. The offer was accepted. The Committee has approved an arrangement with Messrs. Conrad Schmidt & Co., that the contract for a power supply be non-terminable for a period of 10 years, with an option to the consumers of extending the agreement for two periods of five years, or 20 years in all; also new contracts for the supply of energy to the Borough Theatre, Stratford, for a period of seven years commencing September 30th last, and for a supply to, and the alteration of the system of lighting at, the Theatre Royal, Stratford. Under the new contracts all payments are to be made yearly in advance, and a cheque for £702 10s. for the first year's payments has been received.

TRAMWAY and RAILWAY NOTES.

Australia.—The Victorian Government has decided to recommend Parliament to spend £800,000 to carry out the first stage recommended by Mr. Merz, in his report on electric traction on the Melbourne lines. This includes the construction of power houses at Yarraville, and Morwell in Gippsland, and the electrification of the St. Kilda, Melbourne to Port Melbourne, and Sandringham to Essendon railways. Mr. Merz's report also refers to the production and use of electric power in Victoria for general purposes, and deals with the three main questions—(*a*) the future demand for electric power in Melbourne; (*b*) the sources from which such power can be obtained; (*c*) the best way of developing these resources. The main conclusions arrived at are: That advantage should be taken of the establishment of a large generating station for railway purposes to give South Victoria a supply of electric power at the lowest possible price; that the source of power should be, in the first instance, a central station at Yarraville, and that it would not pay to put down a power station at one of the coalfields until the demand had grown considerably; that at a latter stage, when the demand for power had developed still further, additional power should be obtained from a water-power station at Trawool, assuming the irrigation scheme to be proceeded with; that the system of distribution recommended for supplying the railways could to some extent be made use of also in the supply to factories and other power users; that the reduced cost of production resulting from the combination of the two loads would be mutually beneficial, and in the case of the factories would have an important bearing on industry generally. It is estimated that the actual cost at which electric power could be generated, if a comprehensive system of power supply were put down in South Victoria to work in conjunction with the supply for the railways, would be from 40 to 60 per cent. below that otherwise possible.

Belfast.—Mr. Cutler reported that he had gone into the question of the upkeep of the permanent way, and found that the cost per car-mile for the six months ending 30th ult. was ·20d. For the 12 months ending same date it was ·17d. A statement also submitted showed that this compared favourably with other towns in Great Britain. The tramway manager reported that the Bell Punch and Printing Co. had agreed to reduce the charge for its punch to 10s. per annum, whereby a saving of £200 per annum was made.

Dudley.—At last there is a prospect of an amicable settlement of the matters in dispute between the Corporation and the British Electric Traction Co. respecting the purchase by the former, and the release to the latter of the tramways in the borough. So far back as 1897, a draft agreement was arrived at, and it was to have come into operation in 1904; but many things have happened since then, and that agreement has proved a witty document. The items of expense, for instance, had to be arranged by arbitration at the B. of T. This arbitration, however, left unsettled one point which was taken into the law courts, and adjusted in the House of Lords in favour of the Corporation. It was ultimately decided that the value of the tramways was £71,000. The appeal to the House of Lords saved £16,000, but the entire cost of arbitration and litigation has amounted to £6,000. As a matter of fact, in the annual statement of the tramways accounts issued last week, there is an item of £6,294 due to the treasurer on account of the arbitration and litigation. Negotiations as to the

rent to be paid by the company have been proceeding throughout the last 12 months; and the Tramways Committee at its meeting last week had placed before it an offer from the company, which the Committee unanimously decided to recommend the Council to accept. This offer differs materially from the original scheme laid before the Corporation, and the amount of profit to the town will not be exactly what the sanguine fancies of some enthusiastic members have from time to time painted it. Still, the ratepayers will gain by the transaction, while the Council will retain full control of the roads and streets.

Dundee.—In connection with the tramway men's application for an all-round increase of wages, the manager has been instructed to obtain information with regard to wages from Newcastle, where similar questions have been discussed and statistics collected from all tramway centres. A deputation from the men's society waited upon the Council and suggested that conductors, who, in the manager's opinion, were qualified for the work, should be promoted by seniority to be drivers.

Folkestone.—A special meeting of the T.C. was held on Monday morning to consider a letter from Mr. Cownie, representing the Folkestone and Hythe Tramway Co., proposing certain modifications in the company's Parliamentary powers. In all outlying parts of the town, in place of the surface contact system, the company ask to be allowed to use the overhead system, but in the main street leading to Sandgate they would put down a conduit system. The Council by a considerable majority declined to agree to the proposals, more especially as Lord Radnor insisted on a surface contact or conduit system. At Sandgate a similar letter was considered last Thursday, and the U.D.C. adjourned the consideration in order to ascertain if the company would undertake to construct a lift from the High Street to Shorncliffe Camp. At Hythe the Council will not agree to the overhead system, but will consent to an alteration of route in order to avoid some expensive road widenings.

Glasgow.—Negotiations are proceeding between the Corporation of Glasgow and the town clerk of Clydebank in connection with the joining of the Dumbartonshire system with that of Glasgow T.C. at Clydebank. At present there is an interval of about ¼ mile between the respective termini, over which travellers must walk when transferring from one system to the other. The point in dispute is the relative cost to be borne by parties in the widening and constructing of bridges by which the line will be carried over the canal.

Hanley.—The Potteries Electric Traction Co., answering a letter from the Corporation, which asked for the company to proceed with its undertaking to construct a light railway to Bucknell, states its great doubt whether the proposed light railway will prove sufficiently remunerative to justify the expenditure on its construction.

Haslingden.—An extended service of cars was inaugurated on Saturday last; the arrangement under which Accrington has been working the two miles of the Haslingden electric tramways, from the boundary to the centre of Haslingden, being extended to the one remaining mile from the centre of Haslingden to the Rawtenstall boundary, where the steam cars have been retained.

Hertfordshire.—The Metropolitan Electric Tramways, Ltd., have paid £1,594 in settlement of interest at the rate of 4½ per cent. per annum upon the outlay of the C.C. in connection with the promotion and construction of the Barnet Tramways. The plans showing the proposed method of constructing the Watford and Bushey tramway extensions have been agreed on behalf of the B. of T.; an agreement with the Metropolitan Electric Tramways, Ltd., granting for 42 years as from August 21st, a fixed rent of £5 per cent. per annum upon the capital outlay incurred by the C.C., is to be drawn up.

Heywood.—At a meeting of the General Purposes Committee of the T.C. on Monday evening, a recommendation of the Electricity and Tramways Committee was approved, authorising the town clerk to take the necessary steps to obtain a Parliamentary Bill to secure mutual powers for the running of the electric cars in the towns of Heywood, Bury and Rochdale. At present Heywood has a working agreement with the Bury and Rochdale Corporations, and as this will shortly expire, negotiations have been proceeding with the object of making new agreements. Some of the terms submitted by the Rochdale and Bury Committees, however, are considered to be so unreasonable by the Heywood Committee that it proposes to run its own cars, for which it has already got the sanction of the B. of T., and the proposed Bill is to confer on the three Corporations powers of through running.

Huddersfield.—The financial statement respecting the Corporation tramways for the six months ended September 30th last, shows a capital outlay to date of £412,902. The income is:—Passengers, £42,660; postmen, £150; parcels, £602; advertising, £312; coal haulage, £383; and sundries, £4, a total of £44,111, or 10·36d. per car-mile, against £44,118 and 10·84d. in the corresponding half of the preceding year. The total working expenditure is £23,031, or 5·41d. per car-mile, against £20,673 and 5·08d. The gross surplus is £21,080, or 4·95d. per car mile, against £23,442 and 5·76d. After providing £603 for rent of the Linthwaite lines, £6,600 for interest on capital, £4,935 for redemption of debt, and £6,194 for depreciation (3 per cent.), a net surplus of £2,748, or ·65d. per car-mile is left, against £5,110 and 1·26d. in the corresponding half of 1907.

The Tramways Committee has deferred the question of the extension of the tramways from Longwood Church to Dodlee, from Waterloo to Lepton, Grange Moor, and Kirkburton, from Newsome Road to Newsome Church, and from Holly Bank Road to the boundary of the borough at Birchencliffe. In relation to the latter, negotiations are in progress between the Elland U.D.C. and the West Yorkshire Tramways Co. for a connection to be made with the extension and the company's system between West Vale and Elland.

The manager has reported on the six months' trial of the system of 1d. return workmen's tickets, and the Committee has decided to extend the trial for a further period of six months.

Keighley.—At a recent meeting of the T.C., a long discussion took place on the proposal to apply to the B. of T. for power to extend the tramways through Worth Village, to West Lane, and to the Ingrow boundary, and the recommendations were confirmed.

Liverpool.—At a special meeting of the T.C. on Wednesday, it was decided to apply to the B. of T. for a provisional order for the construction of six auxiliary tramways, including the Edge Lane, the Longmoor Lane and the Townsend Lane routes. Sir Charles Petrie, chairman of the Electricity and Tramways Committee, in referring to the Edge Lane section, said trackless tramways had been in vogue on the Continent for some time, and it was the intention of the Council to investigate that particular style, and, if successful, to adopt it.

London.—After discussion at Tuesday's meeting of the L.C.C., it was resolved to seek Parliamentary authority in the session of 1909, to construct the following tramways:—(1) A double line from Harrow Road to Maida Vale on the overhead system; (2) a double line *via* Farringdon Road to a point north of Charterhouse Street on the conduit system; (3) a line partly double and partly single on the conduit method from Mare Street to Wick Road; (4) a single line from Essex Road to Kingsland Road, a junction line between Kingsland Road and Dalston Lane, and a single line from Kingsland High Street to Amhurst Road; (5) a single line from New North Road to City Road; (6) a double line from Battersea Park Road to King's Road, the last three being also on the conduit system; whilst the overhead method is proposed for (7) from York Road, Wandsworth, to Putney Bridge. It was also decided to seek powers to reconstruct the lines from the terminus in Tooley Street *via* Jamaica Road to Evelyn Street, Deptford, from the Archway Tavern to a point near Southwood Lane; and from Rainton Road *via* Woolwich Road to the junction of Trinity Street and Albion Road. The cost of construction and equipment of the proposed new tramways was estimated at £268,000, and that of the lines for conversion would amount to £297,000. A further scheme decided upon for the next session was for a tramway on the conduit system from Streatham High Road *via* Mitcham Lane to Mitcham Road.

Morecambe.—At a special meeting of the T.C. on Monday a resolution was passed by 17 votes to 1, authorising the Council to make application to the B. of T. for a provisional order to extend the tramways, which the Council had recently purchased from the Morecambe Tramways Co., along the front.

Oldham.—The Corporation Tramways Committee proposes to extend the tramway system to the borough boundaries at Moorside and Chadderton, and to run omnibuses and motor-cars on the trolley system without rails, while the Electricity Committee intends to extend its radius of supply.

Rowley Regis.—At the meeting of the U.D.C. on Monday, it was reported that a deadlock had arisen with respect to the carrying out of the Rowley Regis, Brierley Hill, and Quarry Bank tramway scheme, owing to the authorities, through counsel, having insisted upon a clause being inserted in the agreement for the Tramway Co. to deposit £5,000 as security for 40 years.

TELEGRAPH and TELEPHONE NOTES.

Brussels.—On Thursday night last week a fire broke out on the third floor of the Post Office, in the telegraph department, and spread rapidly; the roof fell in, and the telegraph wires of the international service were interrupted. The fire was got under control in a couple of hours, but great damage was done.

Italy.—It is contemplated to set up a telegraph line to the top of Monte Rosa, a height of 4,538 m. above sea level. It will be afterwards extended to the Observatory on the Col d'Ollen, then to the Margharita-Hütte near the summit. The erection of the poles in the snow and ice region will be attended with great difficulty.

Telegraphic Interruptions.—

Port Arthur-Chifu	... ...	March 9, 1904
Rhodes-Sitia	... ...	Sept. 17, 1908

Venezuela.—The Venezuelan Government is desirous, according to a correspondent writing from Caracas, of accepting the transfer of the French Co.'s coast cables in satisfaction of the $5,000,000 fine imposed on the company.

(Continued on page 767.)

SUPPLEMENT.

The Selection of Electrical Measuring Instruments for Commercial Tests on Power Plants.

By OSWALD I. DAVIS, A.C.G.I.

With the increase in size of generators and motors, it has been found advisable in recent years, for economic reasons, to defer the full-load guarantee trials until the the machinery in question is erected and in position on its final site. Such trials in the case of a generator include consumption tests, which necessitate careful measurement of the electrical output. Though the switchboard instruments are often used for this purpose (in which case they should be calibrated in position and under working conditions before and after use, and preferably by an independent authority), it is, nevertheless, in the interests of all parties concerned that separate meters be employed. The duty of supplying these frequently devolves upon the contractor, and every large firm should possess an adequate stock of suitable instruments. Although the following remarks are written from the manufacturer's point of view, they also apply to a certain extent to the instruments necessary for the testing department of a large power company.

The general principles which govern the selection of such instruments are :—

(*a*) *Reliability.*—This includes maintenance of accuracy for long periods of time, and in spite of movement and possible rough handling.

(*b*) *Ease of Transport.*—Or, in other words, small bulk, light weight and facility for safe packing.

(*c*) *Suitability under Various Conditions.*—The same instrument to be available for direct or alternating current of different periodicities and ranges.

(*d*) *Ability to be Set Up and Read by Unskilled Persons.*

Ammeters.

These may conveniently be considered under two headings:

(*a*) Those suitable for currents up to about 200 amperes.

(*b*) Heavy-current ammeters.

Ammeters to be used in field circuits come under the first heading. These are preferably of the portable permanent-magnet moving-coil type, with sets of shunts of different ranges. The shunts should all be mounted on one board, and the connecting leads should be of extra length to enable the ammeter to be placed well away from external magnetic fields. It is also advantageous to colour each shunt lead distinctively, and to coil them on a little spring roller mounted on the same base as the shunts, in order to take up any slack. The main connections to the shunts may be arranged in the form of thumbscrews. Such instruments should read milliamperes when used without a shunt.

For alternating currents, electromagnetic instruments designed for the total current are best. Such ammeters should be calibrated at different frequencies, and the necessary corrections made when used. As the disposition of the leads to and from sometimes materially alters the readings, it is advisable to mount the meters on levelling stands, provided with sufficiently long permanent terminal bars. It is generally most convenient to arrange these at the back of the instrument and at right angles to the face. Such ammeters have the disadvantage of not being very deadbeat.

Ammeters of the second class should be of the shunt type for direct current. Temperature errors should be carefully compensated, and the shunt protected by a ventilated cover. The main terminals should be designed with a view to ease in coupling-up to cable and strip of different sizes.

The use of current transformers is the only solution in the case of alternating currents of any magnitude. These transformers may have tappings brought out to enable the range of the instruments to be altered.

Voltmeters.

The writer has a strong predilection for electrostatic voltmeters for general work of this class. A convenient range for a low-tension instrument is 0-150 volts, and this may be extended by the use of a "potential divider," or sub-dividing resistance, to 300 or 600 volts. For lower voltages, which are usually direct, a moving-coil instrument made up as a milli-voltmeter with series resistances, should be employed.

A high voltage (say 0-7,500 volts) electrostatic instrument is preferable for high-tension measurements. If a transformer of ratio 150 to 7,500 and 15,000 volts is added, practically any alternating voltage can be measured by its use as ordinary or auto-transformer in conjunction with one of the two above-mentioned voltmeters.

Wattmeters.

These are certainly the most difficult instruments to choose in order satisfactorily to fulfil all requirements. The dynamometer type is fairly reliable, but the writer has obtained such good results with Kelvin watt balances that he feels he cannot pass them over in favour of any other type, in spite of their somewhat greater expense. They are, of course, arranged to deal with the whole current through the fixed coils, and the moving coils are connected in series with a suitable high resistance, directly across the machine terminals. The weights and carriages should be arranged to give a series of constants in arithmetical progression, and dashpots should be provided for use in cases where the load fluctuates considerably. A rapid means of adjusting the zero is required, and the delicate flexible suspension should be capable of entire detachment for packing.

The series resistance should be divided into units of convenient size and sub-divided by frequent tappings. For three-phase working, two wattmeters should be employed, and the power factor can then be determined for a balanced circuit by the aid of the curve in fig. 1.

WAVE-TRACERS.

For the recording of wave-forms the ondograph is, perhaps, of more portable and substantial construction than the oscillograph. The latter has, however, the advantage that momentary phenomena can be studied. The resistances employed for the pressure coil of the wattmeter can usually also be used in the determination of the potential wave-form.

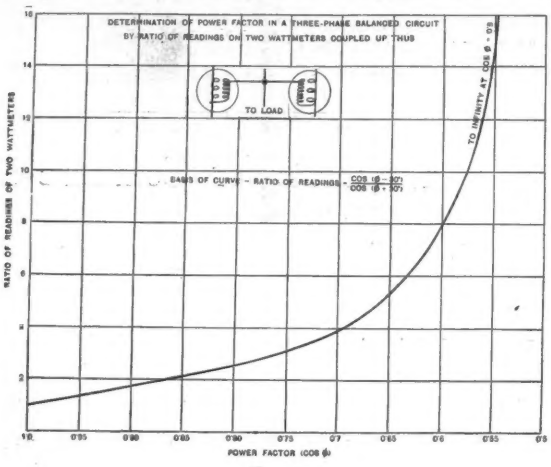

DETERMINATION OF POWER FACTOR IN A THREE-PHASE BALANCED CIRCUIT BY RATIO OF READINGS ON TWO WATTMETERS COUPLED UP THUS
TO LOAD
TO INFINITY AT COS θ = 0·5
BASIS OF CURVE – RATIO OF READINGS = COS (θ − 30°) / COS (θ + 30°)
RATIO OF READINGS OF TWO WATTMETERS
POWER FACTOR (COS φ)

FIG. 1.

An adjustable shunt, consisting of a framework carrying a number of strips of resistance material, each giving the required drop of potential at a certain current, is useful for connecting up the current wave-tracer. The number of such strips is then chosen to suit the current in the circuit to be investigated.

Suitable boxes, furnished with hemispherical rubber or felt pads, should be provided for all instruments, together with arrangements for clamping the moving systems. In cases where the instruments are subjected to vibration, the writer has found the use of soft rubber pads, under the instruments themselves or the legs of the tables on which they stand, most beneficial; suitable pads are sold for the heels of crutches, doorstops, &c. All terminals should be clearly marked to avoid errors in connecting. It is convenient to have separate detachable scales engraved for each constant; such scales may be of varnished cardboard, and can usually be fastened by means of small studs in the face of the instrument, which also serve to bring about the correct alignment. Where individual scales cannot be used, printed tables of readings should be furnished for each constant, to avoid labour and, indeed, often errors in multiplication or division.

AN INTERESTING FEATURE OF THE EXHIBITION.

[COMMUNICATED.]

THE Manchester Exhibition is an electrical exhibition. Everyone agrees that it is probably the finest of its kind that has ever been held in Great Britain. Press comments of all descriptions have been made upon it, and no better text could be found for the sermons which electrical canvassers will preach to prospective consumers. But there is one interesting point which has, so far as we remember, been hitherto overlooked.

Anybody remaining long in the Exhibition must be impressed with the remarkable amount of gas that is present, in view of the main objects of the demonstration. We are not attempting to be funny over the spirited conversations that are indulged in between would-be sellers and doubtful buyers. We refer to the very large number of exhibits of gas engines, gas producers, oil-vapour plant, and accessories to this line of business. A brief reference to the Exhibition catalogue will suffice to show the extent of this section.

F. V. Brown & Co. are showing anthracite suction gas plant and dynamo supplying current to motor-driven pumps. T. H. & J. Daniels, Ltd., have suction and pressure gas plants for anthracite coke or charcoal fuel, together with gas engines of the latest type. The James Keith and Blackman Co., Ltd., show blowers especially designed for starting suction gas plants, or for use in conjunction with producer gas. The General Electric Co., Ltd., have a country house exhibit using ordinary paraffin as a motive power. Electromotors, Ltd., show steam and petrol sets suitable for pilot lighting in mills. The Nuremberg Gas Engine Co., which has since 1902 supplied or obtained orders for upwards of 305,570 B.H.P., has illustrations of large gas engine installations; Mirrlees, Bickerton & Day, Ltd., have an exhibit consisting of a 150-B.H.P. Mirrlees-Diesel oil engine driving a 100-KW. dynamo. Crossley Bros., Ltd., have installed one of their patent suction gas plants driving a four-cylinder vertical gas engine; the National Gas Engine Co., Ltd., show one of their latest models served by a producer gas plant; and the Heatley-Gresham Engineering Co., Ltd., are showing oil-engine combined sets for hotels, public buildings and the like.

It is useless, therefore, to say that no prominence is given to the gas industry in this Exhibition, and visitors may be pardoned if they leave the show with an impression that the gas engine is anything but an outsider. Now, two of the vice-presidents of the Exhibition are the Mayors of Manchester and Salford, both owning electricity supply systems of large magnitude; the third vice-president is Sir William Preece. The Chairman of the Exhibition Committee is the Deputy Chairman of the Manchester Corporation Electricity Committee; his second is the Chairman of the Salford Electricity Committee. On the General Committee of the Exhibition there are representatives of three Corporations and one supply company donating to the funds; there are two representatives of the Institution of Electrical Engineers, one of the Municipal Electrical Association, three of the National Electrical Manufacturers' Association, and two of the Electrical Contractors' Association.

With these gentlemen actively associating themselves with the organisation of the Exhibition, having the knowledge that the Manchester Exhibition will probably be, for years to come, the reference point for non-technical and technical customers, how does it happen that so much display has been made of gas production and gas utilisation? What is the point of view from which this has been regarded?

It may be taken for granted that these exhibits were not let in just to fill up blank spaces. The popularity of the Exhibition is far too great for that. The only possible solution, and one that is well substantiated by fact, is that the owners of centralised electricity supply are not in the least degree afraid of the competition either of suction gas, producer gas, or ordinary town gas. The manufacturers and contractors probably realise that in country districts untouched by electric power supply systems, they have a chance of selling motors and lamps if a suction gas plant is installed to supply energy, and for this reason they would give their support to the inclusion of these exhibits. But the voting power of the supply interests, and the financial power that they gave to the enterprise, would have prevented any such exhibition had they considered that it entailed a serious menace to their own interests.

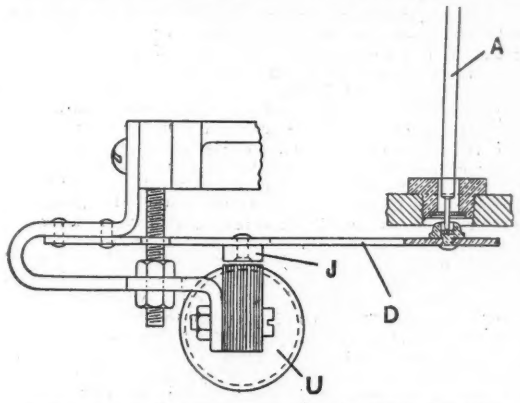
As a matter of fact, taking Manchester itself as an example, it is open to considerable doubt whether, in the area of supply, the gas-driven private plant would have a chance of successful competition with power supply by electricity. And in this point of view lies the solution to a competition which is merely caused by a misunderstanding of the facts. Let it be granted that for town areas possessing a cheap supply of electricity the suction-gas plant has a very slender chance, while for country districts an admirable field is open for this motive power; then the energies of those firms who are exploiting gas plants will be focused on the outside districts, doing away with an irritating competition, producing better results in an open area, and bringing nearer the day of the complete use of electricity for all purposes, both in town and country.

INSTRUMENT EXHIBITS.

Siemens Bros. Dynamo Works, Ltd. (86, 97).

It goes without saying that this company's display of instruments and such like apparatus, is well worth inspecting.

Several prominent types of meter are shown. Of these the G 4 type is a leading example and is suitable for either alternating or direct current; its outstanding feature is the provision of a removable commutator, brushes and lower bearing. The exchange of these parts—a matter of moments only—practically renews all the wearing parts and leaves the meter as good as new.



The Siemens Magneto Vibrating Footstep Bearing.

Further, the calibration is unaffected, and the exchange can be made on the consumer's premises.

We illustrate the above meter, which can be arranged for double tariff purposes, with a double dial to work in conjunction with a time switch, also shown on the stand.

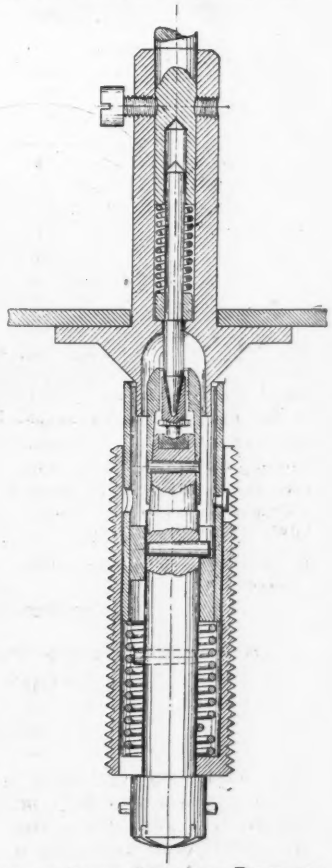
A traction meter exhibited is fitted with a novel spindle, the lower end of which is provided with a spring-supported pivot resting in a jewel which is also spring-supported—this arrangement being calculated to eliminate entirely the harmful effects of vibration on the meter. This arrangement is also illustrated.

In the case of alternating-current meters, especially where those meters are required to register very small currents—a requirement which the adoption of small transformers for metal-filament lamp circuits has emphasised—the firm is fitting an ingenious footstep bearing, the arrangement of which will be seen from our diagram. The armature J is caused to vibrate in the alternating field produced by coil U; spring D communicates this to the spindle A through the intermediary of the jewel bearing—the action being similar to the familiar tapping of an instrument by hand. The arrangement enables a 300-ampere meter to start on ½ ampere.

A cheap type of meter—brought out in reply to the appeal of the central-station man faced with stringent loan conditions—is also well worth attention.

A variety of switchboard and laboratory instruments is also shown, including ammeters, voltmeters, &c., of several types under the former head, and a number of galvanometers, resistances, current transformers, &c., under the latter.

The Siemens G4 Type Meter.



Siemens Spring-Supported Pivot and Bearing, for Traction Meter.

Schaffer & Budenberg, Ltd. (112).

This stand "fixes" the visitor at once, the display of a couple of hundred pressure gauges for which the firm's name is a household word among engineers in all parts of the world (as it ought to be after 60 years!), being impressive. Those shown in the scheme of ornamentation of the stand range from 2 to 12 in. in diameter.

Various other specimens of the firm's manufactures also form part of the exhibit. They include pressure and vacuum gauges on the Schaffer, Bourdon, steel tube, and steel tube hydraulic, principles for all industrial purposes and in sizes up to 18 in. diameter. Recording or registering gauges form an important department of the firm's gauge business, and test or control gauges are another department. Among the specialities on exhibition are a patent electrical distance pressure recorder and electric alarm gauges. The former of these is designed to meet cases where pressure is to be indicated at distances too great to allow of the indicating gauge being connected to the source of pressure by ordinary piping. It consists of a pressure gauge, dry cell, receiver, or recorder gauge with differential galvanometer and contact knob. The receiver or recorder gauge can be fixed at any distance from the pressure gauge, being electrically connected. The electric alarm gauges are intended to give an audible alarm by causing an electric bell to ring as soon as a predetermined pressure is reached. Such gauges are made with fixed alarm, and ring only at one certain pressure, or they are arranged so that the pressure at which the alarm is to be given, can be varied by adjusting the contact arrangement from the outside. In such gauges provision is made to prevent any unauthorised person from tampering with the adjustment.

The variety of boiler fittings includes iron and steel valves, cocks, water gauges, biflux valves, and the compound equilibrium stop valves. The last-named are a new type just placed upon the market. The valve proper is of a conical section and simultaneously closes two passages, the combined area of which is equal to the main inlet or outlet or the nominal size of the valve. Owing to the smallness of the valve proper, and to the fact that little power is required to open and close the valve, the upper neck of the body, the cover bridge, and handwheel, &c., are all comparatively small. This has further advantages, inasmuch as the cover only offers a comparatively small area to the steam pressure, and the bridge, pillar, spindle, &c., are subjected to very little strain. Further advantages claimed are:—(1) When the valve is only partially open, the plug is lifted quite clear of the lower seating, thereby obviating the rapid wear of the seatings due to the increased velocity and scouring action of the steam; (2) the reduction of noise often observed due to the steam cutting on the sharp edges of the ordinary valve wings and the rotation of the valve proper on the spindle; (3) the stuffing box is of a novel type. The seating rings are of nickel.

Water level indicators and alarms, injectors (a special feature of the firm's manufactures), test and pressure pumps, the Kryszat patent air compressor, engine governors, indicators, and lubricators; tachometers, Graham's patent twin gas engine counters, thermometers in various grades and designs, and a thousand other things are among the Schaffer & Budenberg manufactures, of which so representative an exhibit is made.

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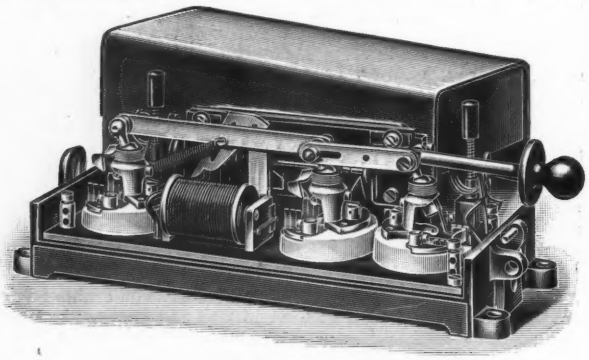
Nalder Bros. & Thompson, Ltd. (188, 216).

Messrs. Nalder Bros. & Thompson are exhibiting all types of their moving-coil or permanent magnet instruments for direct-current measurements, and soft or moving-iron instruments for direct and alternating-current measurements, including some quite



NALDER EARTH-LEAKAGE AUTOMATIC SWITCH.

new patterns of both types in round cast-iron cases, and in sector and edgewise cases to suit all switchboard requirements.

The moving-coil instruments are, of course, damped by Foucault currents; the moving-iron type are air-damped, the feature of the device employed being the easy accessibility of the air chamber.

The large illuminated-dial instruments for central-station use, portable standard voltmeters, and the "Ohmer," which is now too well known to need much description, are all exhibited. The free-wheel is a feature of the Ohmer, and its absolute indifference to stray magnetic fields is a very great advantage. Some of the Ohmers are now fitted with visible indicators of the vibrating reed type, to show what voltage is being given by the hand generator.

An electrostatic voltmeter of the Ayrton-Mather type, for the accurate measurement of high voltages, is another exhibit, together

NALDER GROUND DEIECTOR.

with instrument transformers for pressure and current, enclosed in iron cases which are made to contain oil.

Ground detectors are exhibited both for direct-current and alternating-current work. It is claimed that the alternating-current ground detector of Messrs. Nalder Bros. & Thompson, Ltd., is the only one on the market that complies with the Home Office

DEYSDALE WATTMETER.

regulations for mines. It makes use of the principle, suggested originally, they think, by Mr. Raphael, of superimposing a small direct current from a battery or other source upon the alternating current circuit, and this enables the absolute insulation resistance of the circuit to be read directly in ohms. The ordinary alternating-current ground detector only indicates when one of the mains has a worse insulation than the other, and it may happen that both mains are in a very bad condition and a source of danger, and yet the leakage indicator will give no indication. This ground detector, which we illustrate, effectively gets over the difficulty.

A new earth-leakage switch is exhibited by the firm. It is connected in the main circuit, and a leak to earth of an amount of current far too small to sustain an arc or produce enough heat to cause a fire at once causes the main switch to open; the switch cannot be closed again until the leak is removed. It is well known that fuses on a circuit do not afford protection from a fire caused by leakage of current to earth, a function which is filled by this switch (see figure).

The wattmeter invented by Dr. C. V. Drysdale finds a place on Messrs. Nalder's stand; the errors due to the iron in this instrument are negligible, the increase in the working forces and consequent elimination of friction errors more than compensating for any slight errors due to hysteresis and wave deformation. Another novelty is an electric telethermometer, designed for use in cold-storage warehouses or cold-storage ships. The rapidity and certainty with which any number of thermometers can be read with this apparatus from one centre, such as the engine room or officer's cabin, is worthy of attention. The present method consists of hauling a glass thermometer up a tube from the hold of the ship, making allowances for the change of the reading during the time it is being pulled up and read on a dark, stormy night, and recording the reading, as far as it can be remembered, with half a dozen others, on the engineer's cuff.

A tool for marking off with extreme accuracy large templates, slates or other work is shown, and there is a large display of the firm's well-known circuit-breakers and other switches, including a new "jigger switch" which it is proposed to apply to the method of charging for electricity supply on the "limit-demand system." As soon as the maximum demand permitted is exceeded, the jigger switch comes into operation and jigs the light in an unbearable manner, and goes on jigging until the consumer switches off current and brings himself within the maximum demand contracted for again.

The Crawley automatic cut-out, which has no permanent magnets or any parts that can be demagnetised, is too well-known to call for more than mention.

Union Electric Co., Ltd. (175, 231).

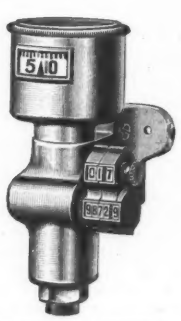
A large display of Hartmann & Braun instruments of all sorts and sizes—some very large—is exhibited on this stand; the Hartmann-Kempf frequency meters, of the vibration type, in many patterns, form a very interesting feature of the collection, and are shown in operation. A speed recorder with paper chart, and a number of laboratory instruments, testing sets, &c., are exhibited.

A convenient "switch pillar head" is shown, carrying the new "Sector" flange instrument and a double-range frequency meter, the whole being fitted with illuminated dials, and suitable for the control of A.C. machinery. A 15-ampere time meter for consumers' circuits, and a time-meter for use on tramcars, showing only the length of time during which the current has been on, are worthy of notice; a temperature indicator for electrically indicating temperature at a distance, and a standardising electro-dynamometer, also are of special interest.

Electric and Ordnance Accessories Co., Ltd. (1, 62).

An interesting new instrument shown by this company is the "Warner" Autometer—a combined speed indicator and distance recorder for use on motor-cars, tramcars, &c. It is actuated by a permanent magnet, which is guaranteed not to lose ½ per cent. of its magnetism during a period of 10 years; this is driven by a flexible shaft from the axle, and drags round an aluminium dial by eddy currents, against the control of a hair-spring. The dial is uniformly divided throughout the whole range, and is carried in sapphire jewelled bearings, reducing friction to the minimum. The accuracy of the readings is unaffected by the position of the car, and oscillation is practically absent except on rough roads, the dial being carefully balanced. The accompanying figure shows the appearance of the instrument.

The company are also exhibiting their telephones, which are made for use on the central-battery exchange system, call and reply, domestic, and central-battery intercommunication telephones. We illustrate herewith one of their hand sets.



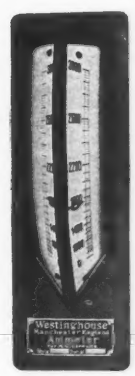
"WARNER" AUTOMETER.

STELLITE HAND SET.

British Westinghouse Electric and Manufacturing Co., Ltd. (79, 103).

The Westinghouse Co. are showing their new type "O" D.C. ampere-hour meter, an extremely simple meter, especially suitable for small consumers. It is of the shunted type, in which a small motor runs in parallel with a resistance, through which the main current flows. The speed of the armature is proportional to the drop across this resistance. The commutator is very small, reducing

Westinghouse "N" Type Single-Phase Watt-Hour Meter.



A.C. Ammeter.

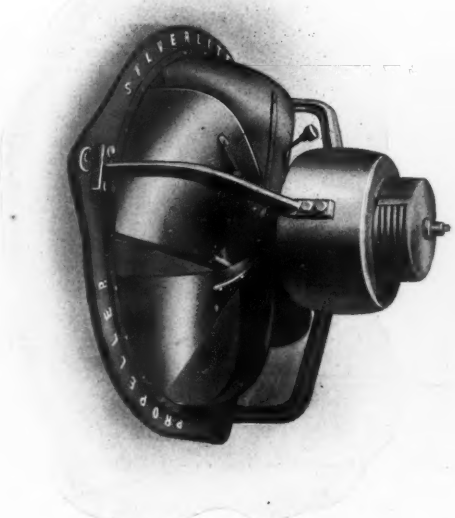
friction and wear from this source to a minimum. The meter cannot run idle, and all losses due to shunt winding are avoided. The meter is very compact, its overall dimensions being 5 in. wide, 6½ in. long, and 5 in. deep.

The type "N" single-phase watt-hour meter is for two-wire circuits of all usual frequencies. It is small and very compact, of simple and strong construction, and unaffected by variations of pressure in the supply circuit. The speed is low, and the moving element extremely light. The permanence factor, *i.e.*, the ratio of the torque to the weight of the moving element, is very high. An accuracy of within 2 per cent. from $\frac{1}{20}$th of full load to 25 per cent. overload is guaranteed for one year. The meter is illustrated herewith.

Another view shows a two-faced A.C. ammeter, which can be read from either end of a switchboard.

Rochdale Electric Co. (13).

The chief feature of this company's exhibit is the "Watson" prepayment meter. These meters are made throughout at the company's own works at Rochdale, and are manufactured for



"Silverlite" Electric Air-Propeller.

penny-in-the-slot or shilling-in-the-slot, and for alternating current as well as direct current.

The chief points claimed are: No current is absorbed in operating the measuring device, and there is no appreciable drop in volts at full load, no shunt current being employed; no liquids or mercury contacts are used; the company's new patent coin trap rejects all bent coins, and no wires or string can be put through into the meter to foul the mechanism or divert the current; a simple and very effective device is provided for adjusting the amount of electricity to be given for a coin's worth; a bold indicator finger shows the consumer how many lamp hours he has still to his credit. There is also a check dial to safeguard the supply company against cheating.

Other exhibits include a standard 3-H.P. 220-volt motor, which represents a range from 1 H.P. to 60 H.P.; the "Silverlite" electric air propellers with open type blades and with box blades; a compact motor-car accumulator charging board, with ammeter, automatic no-volt switch, and variable lamp resistance; and iron, brass and aluminium machine-moulded castings, of which the company make a speciality.

Two machines cutting clockwork gear wheels and pinions, such as are used in the "Watson" slot meter, form an interesting exhibit; these machines are fully automatic, and are electrically driven by one of the company's 1-H.P. motors. Lastly, the stand is lit up by "Silverlite" metallic-filament lamps, which are working in pairs on 200 volts, and also others direct across 200 volts. These lamps can be supplied in voltages from 6 volts to 250 volts, and the consumption varies from 1·1 watts per C.P. to 1·25 watts per C.P., according to size and voltage.

Pollock & McNab, Ltd. (110).

Messrs. Pollock & McNab's "Apollo" lathes are too well known to need lengthy reference here; the exhibit includes turret and capstan lathes, drilling, milling, and automatic gear-cutting machines.

The Bristol Co. (J. W. & C. J. Phillips) (3).

On this stand are shown the Bristol Co.'s standard recording gauges for steam, vacuum, and air pressure, also voltmeters, ammeters and wattmeters, some of which are recording on the Exhibition supply. An exhibit of interest to central-station men in particular is the Bristol thermometer for recording the temperature of superheat. The principal feature of the instrument is a hermetically sealed bulb about 6 in. long × ¾ in. diameter, connected to the recording gauge by 25 ft. of protected tubing, the bulb being sealed under pressure, and containing a gas. The superheat recorder has a range up to 800° F.; a lower range shown for recording the temperature of feed water runs to 400° F. There is also on view a new pyrometer recently introduced by Prof. Bristol, which will record and indicate temperatures up to 3,000° F. This is worked by an electric couple.

Glenfield & Kennedy, Ltd. (5, 6).

Practically every engineer knows the Kennedy water-meter, which is shown working on this stand in a glass body; but the company's products extend far beyond the meter, as is instanced by the sluice, air, pressure-reducing, and exhaust valves shown.

An electric water-level indicator and recorder, for registering in a town the depth of water in a distant reservoir, is particularly worthy of mention.

The apparatus is composed of a transmitter and receiver; the former consists essentially of a two-way switch, operated by a float through suitable mechanism, and coupled electrically to a relay in the receiver. The relay decides as to which of two sets of electromagnets (in the receiver) shall be energised; and these magnets, through their armature, control the direction of rotation of the indicating dial. The receiver is provided with a dial marked in

"Watson" Prepayment Meter, Closed and Open.

feet, a recording drum, and a clock, and thus provides for graphical records of the rise and fall in level.

Another interesting instrument is a discharge recorder, for integrating and graphically recording the water passing over a weir, and its depth. The company are making a special display of automatic exhaust and other valves; and it is worth noting that they have carried out all the valve work for the Loch Leven hydro-electric scheme.

Elliott Bros. (85).

Messrs. Elliott are showing a large number of instruments under actual working conditions, in conjunction with switchgear manufactured by Messrs. Eckstein, Heap & Co., their agents in Manchester.

Moving-coil ammeters and voltmeters for direct-current switchboard mounting are shown in various sizes of round and sector types, as well as edgewise instruments, some of them having illuminated dials.

E.B.L. PORTABLE AMMETER AND VOLTMETER.

Dynamometer instruments for alternating current are shown to match the moving-coil instruments, in all types except the largest round pattern and the smallest sector type.

Portable instruments are shown of every description, for direct or alternating current, and also some types for use on both. The alternating-current instruments are of the dynamometer type, with a special arrangement of the coils, there being only two coils of wire instead of three. In the ordinary dynamometer, the moving coil swings inside the long fixed winding formed by the two fixed coils. In this form the arrangement is reversed; there are two coils only, and the moving coil swings outside the fixed coil, which is wound in the form of a ball. It is claimed that the electrical efficiency of the instrument is increased owing to the better disposition of the windings; and that this allows stronger controlling springs to be used with a coil of relatively less weight and inertia, without the accompanying disadvantage of an increased coefficient of self-induction.

The portable standard ammeters are accurately compensated for temperature by means of Campbell's patent compensating device, of which the firm are the sole manufacturers.

ELLIOTT BROS' A.C. AMMETER.

In all the instruments above-mentioned, a special feature is made of the external zero device, enabling the pointer to be accurately set to zero.

Recording instruments are shown in actual operation, both for continuous and alternating currents. These are of the latest pattern, made at Century Works, and embodying several important features. The instrument consists of three essential parts:—The case, the clock, and the electrical movement—each of which forms a separate unit, and all of which are interchangeable with similar parts in another recorder; consequently, in the event of any injury happening to the clock, it can easily be replaced by another clock without having to send the whole instrument back.

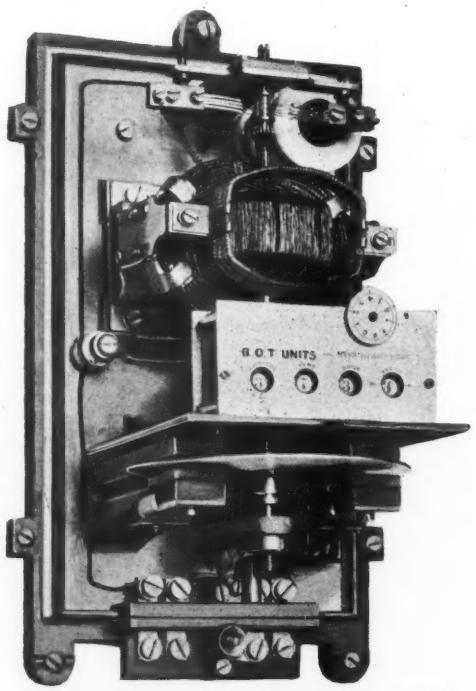
They are made with a variety of speeds of travel, and in particular one instrument is provided with 1 in. per hour and 1 in. per minute speeds, the change being effected by a small lever, so that the quick speed can be used during certain tests, and the slow speed switched on when the tests are not being made.

A tell-tale device can be supplied for use during the night, when it is necessary to be assured that the station attendant has taken the readings.

An important accessory is the new "Century" pen, the result of experiments carried out to obtain a pen which would properly mark a chart, and at the same time would not run out too quickly as regards inking. The new pen does this, and is cheaper than the form previously used.

ELLIOTT RECORDING VOLTMETER.

Transformers and shunts, leakage indicators, and the Harrison universal photometer are exhibited, as well as test sets of various forms, including the "E.B.L." test set, which we illustrate.



INTERIOR OF ARON MOTOR METER. (See p. 753.)

A large variety of galvanometers and other laboratory apparatus, telegraph apparatus, engineering instruments, Sparklet fuses, &c., is on view, as well as the die castings for which the firm is noted. By the latter process, pieces can be cast accurate in shape and to dimensions, within 0·001 in. Screw threads can be cast and holes located accurately in any parts of the pieces, the majority of which

can be taken straight from the moulds and assembled without any grinding or drilling being required.

The Elliott speedometer is shown in operation, and a case containing the various medals awarded to the firm at various Exhibitions.

Aron Electricity Meter, Ltd. (131).

The Aron Meter Co. are exhibiting a large number of energy meters, including their standard patterns of induction type and direct-current motor meters, their well-known clock type meter, &c. The induction motor meters are shown in various types. Besides the ordinary standard house service pattern, there are switchboard instruments, two-rate meters, three and four-wire polyphase meters, and the prepayment meter, the latter being the only meter of its class to receive the Board of Trade approval. In the direct-current class examples are shown of the company's new ampere-hour and watt-hour motor type meters, which we illustrate (p. 752), and their D.C. prepayment meter, consisting of an ampere-hour meter, coupled with the same prepayment device as is used in the A.C. prepayment meter.

A large number of clock meters are exhibited, including single and double-dial charge and discharge battery meters, 2-rate meters,

Aron Master Clock.

maximum demand meters, house service meters, and station meters. The latter consist of many kinds of polyphase switchboard meters and large current traction and portable meters of the whole current and shunted types. For checking meters *in situ*, a portable meter is shown; this is used in conjunction with a portable resistance, which forms a very handy adjustable artificial load.

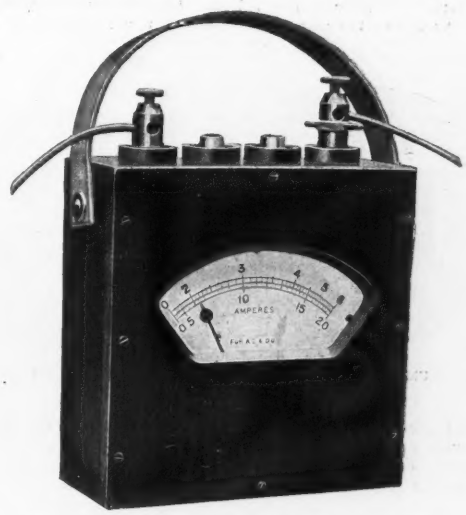
A complete system of electrically-wound master and sub-clocks is shown; many of the latter are fixed in prominent positions around the Exhibition. We illustrate herewith the master clock, showing the interior. Clocks suitable for offices, private houses and switchboards, and for ringing bells, burglar and other alarms are also exhibited.

Single and double contact time switches, suitable for switching in different meters, &c., at predetermined times, or altering the rate of a meter, are exhibited, as well as main current single and double-pole time switches for heavier work; hour counters, for registering the total hours during which a circuit has been in use, suitable for A.C. and D.C. circuits, and taximeters for horse and motor cabs.

Evershed & Vignoles, Ltd. (226).

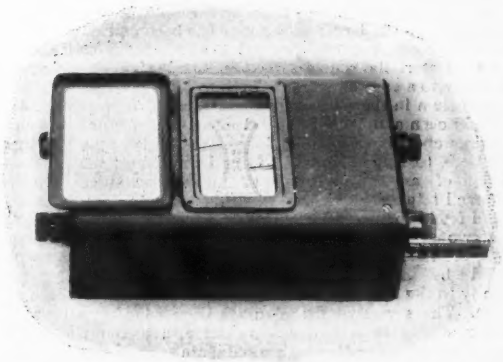
The well-known "Megger" is, of course, the leading feature of Messrs. Evershed & Vignoles's exhibit; our readers need no description of this. Their new Evershed three-range portable ammeter for D.C. and A.C. is an interesting instrument; it has been designed to provide as far as possible the same advantages for alternating currents as the shunt system does for direct. It is made with four terminals, and according to the pair of terminals to which connection is made, its range is either 10 amperes, 60 amperes or 100 amperes; in this manner the whole range from 1 to 100 amperes is satisfactorily covered by one instrument, with an enormous saving of weight, since the only alternative is the provision of three instruments, or a single instrument with three transformers and three shunts. The movement is dead-beat in action, and is unaffected by external fields. A similar instrument with two ranges is shown in one of our figures.

Another exhibit is Evershed's combined portable moving-coil ammeter and voltmeter for direct current, which is illustrated herewith. This instrument contains two movements mounted at either end of a common magnetic circuit. The pointers work over two scales divided into 100 and 130 equal divisions respectively, on a common dial. The instruments are, electrically, entirely independent, and in addition to serving for the measurement of volts and amperes, can also be used for measuring watts or ohms. The standard instrument is provided with four shunts for the ammeter, enabling all currents to be measured from ·001 to 1,000 amperes, while the voltmeter is provided with an internal switch and resistances which give six sensibilities, and enable readings to be taken of any pressure between ·001 and 1,040 volts. By taking simultaneous readings of volts and amperes, the watts may be measured by simple multiplication; and the possible range is from one-millionth of a watt to one million watts.



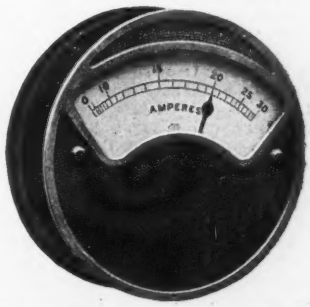
Evershed Portable Two-Range A.C. Ammeter.

The Murday recorder, an instrument of the moving-coil type in portable form, is provided with a special patented construction of the pen which renders levelling screws unnecessary, while the



Evershed Combined Portable Moving-Coil Ammeter and Voltmeter.

motion to and fro over the paper is such that the time scale becomes a scale of straight lines instead of curves as is usual. This special construction is particularly valuable in portable instruments. The



Evershed Switchboard Ammeter.

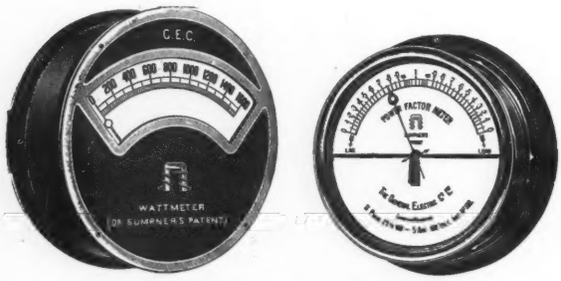
shunts are of a special patented type constructed so as to reduce the space usually occupied.

In addition to the foregoing, there is an exhibit of Evershed's moving-iron instruments for switchboards A.C. and D.C., mounted in

cast-iron enamelled cases as illustrated, with the movement rendered dead-beat by the provision of an air damper of special design. The instruments are particularly suited for motor circuits of all kinds, and being water-tight and extremely strong in construction are specially suited for underground use.

General Electric Co., Ltd. (132, 162).

A variety of instruments is shown at the General Electric Co.'s stand. Of these the principal features of novelty are the Sumpner



SUMPNER POWER-FACTOR METER AND WATTMETER.

alternating-current instruments, with iron cores. We illustrate herewith a power-factor indicator of this type, which is made for balanced or unbalanced loads, and is a very useful instrument in generating and sub-stations. A typical 2,000-volt 200-ampere generator panel is exhibited, on which are mounted a power-factor indicator, a moving-iron illuminated-dial voltmeter, main and field ammeters, and a Sumpner indicating wattmeter. The last named has a large torque and an evenly divided scale, and attains to a very high degree of accuracy. The Sumpner instruments were fully described in a paper read before the I.E.E., of which an abstract appeared in our issue of April 17th last. Various patterns of recording meters are exhibited, as well as a complete range of telephones for common-battery and other exchanges, intercommunication telephones, &c. In this connection we may note that the company are now making porous pots and dry cells complete at their Witton works, where they have been making carbons also for years past. An unbreakable gas lighter of the static type, in a metal case, is an item worthy of notice. We understand that the Fynn alternating-current motors are made by the General Electric Co., and one of them is exhibited.

Ferranti, Ltd. (80, 102).

Messrs. Ferranti's chief exhibit is, of course, the high and low-pressure switchgear in the Exhibition sub-station adjoining their stand, which was described in our issue of October 2nd.

On their stand they exhibit a number of interesting details of their manufactures, including a group of all classes of electricity meters for house service, for both alternating and direct-current supply, and switchboard meters; their switchboard and portable types of instruments, including power-factor indicators, indicating wattmeters, frequency indicators, relays, leakage indicators, &c., are also shown. Various sizes and types of starters for direct-current motors are exhibited; these starters are radically different from other starters on the market, being practically indestructible, and having no wire coils or spirals.

The remainder of the exhibit consists of electrically and mechanically-operated switches constructed on the lines of Messrs. Ferranti's patents, and a small complete low-pressure power switchboard which they have built for their own power station at their works at Hollinwood.

Motor Loads in Hotels.—To the central station which numbers one or more modern hotels among its customers, the chance for the development of power business is worth following closely, for there is no field where the advantages of the electric motor are more conspicuous. The great problem in operating an hotel is to keep the labour cost down, since in many houses there are often from one to one-and-a-half employés per guest. The organisation of the larger city hotels has been carried to a point of great refinement, but it is a question whether the staff could not be very materially reduced by the installation of motor-driven machinery to a greater extent. Labour-saving devices are therefore at a premium in the management of the most progressive hostelries. In the kitchen and laundry the electric motor affords the cleanest of all powers. It economises floor space, enables the best lighting conditions to be enjoyed in the culinary department, allows the location of any machine at the most convenient point, and thus facilitates the quickest handling of both raw materials and cooked food products. It is a great convenience to be able to put a motor-operated machine well out of the reach of the ranges, ovens, broilers, cold-storage chests and other equipment frequently visited by employés, and here the motor drive contributes directly to the acceleration of the service to and from the dining rooms. The severity of the surrounding conditions causes little embarrassment in a motor installation, and the time spent in repairs by the generally overworked maintenance staff of a modern hotel is seldom chargeable in any considerable proportion to the electric motor. In almost every department the convenience of the motor drive justifies its adoption. Passenger and freight elevators, semi-automatic hoists and dumb-waiters, dish conveyers, ash hoists and coal lifts, form a class of equipment by itself especially adapted to motor driving. The electrically-driven dumb-waiter has reached an advanced stage of development in the later hotel work, especially in its automatic features. In the electrical operation of bread-mixing machinery, apple parers, bread-moulding machines, ice-cream freezers, fruit cleaners, pie trimmers, coffee grinders, meat and food choppers, silver polishers, knife grinders, cutlery brighteners, pitcher and silver buffers and scrapers, ice crushers, dish-washing machines and other smaller apparatus, there is an excellent chance to save labour through the use of the electric motor. Over steam the efficiency is undisputed, but the chief gain to the hotel management is, as indicated above, in the cost of attendance. When a single chopper driven by a 1-H.P. motor will handle from 500 to 750 lb. of meat in an hour; when a 2-H.P. washer will clean 3,000 dishes in 60 minutes, and a knife polisher brighten 250 knives in half-an-hour, the possible savings in hand labour become attractive. The cost of the machine is a small matter when its capital charges and operating expenses are balanced against the wages item with and without the machine, under the conditions usually prevailing in hotel service. In the field of general motor application, driving small fans, pumps, refrigerating apparatus, and notably in keeping the odours of the kitchen away from the cafés, corridors, &c., in assisting fireplace ventilation, or in extracting smoky air from the banquet rooms, in operating sewing machines in the linen division, and in numerous other uses, the electric drive can be made so serviceable that the central-station man who fails to emphasise these features in seeking to enlarge his power load in the hotel field lets slip an excellent opportunity to secure business of the most desirable kind.—New York *Electrical Review*.

J. Lomax Kendal & Co., Ltd. (100).

This firm has acted as contractors for much of the installation work in the Exhibition, this including the electric wiring contract in connection with the arc lighting circuits, and the general domestic lighting of the dining room, tea room, and the Welcome Club. But it also has a stand of its own, where there is an array of many recent designs of Veritys' electric fittings for residence lighting, including work representing the Adams, Sheraton, Louis XVI and the Flemish Schools. Here also is one of the few exhibits of electric heating and cooking apparatus, which comprises Veritys' radiators and convectors, and some new cooking and heating utensils of Veritys' manufacture, now exhibited for the first time. Some switch and socket covers are shown illustrating the method of sinking the switch and sockets into the wall; the plates and covers can be made of ornamental design to agree with the electric light fittings employed in the room where they are placed. A novelty of greater interest than these is found in the "Witch" dust extractor for domestic use. It is claimed to be an extremely effective device, is driven by means of a Verity motor, and its current consumption is stated to be one-fifth of a B. of T. unit per hour.

"Check-fire" Door Co. (182).

The company's exhibit includes examples of their new fire-resisting doors, which, it may be mentioned were patented in 1904, and have since undergone prolonged trials.

This door consists of an angle framework carrying a slab of insulating asbestos composition between a thin sheet-iron plate, on one side, and a perforated iron plate on the other.

It is intended that the solid sheet metal side of the door shall face the room to be safeguarded from the spread of fire. The sheet-iron, being very thin, buckles under red heat between rivets, but without deforming the door, and forms air cushions for protecting the insulating material behind.

The final layer of insulation on the other side, next the perforated plate, is a slab of asbestos slate, which is both fire and waterproof, and contributes largely to the rigidity of the door.

The perforated slate exposes, through its perforations (about 2,600 to the sq. yard), a large portion of the slate to air cooling. The perforated plate is claimed to be inert under heat, so much so that the door is still fireproof even if the fire originates on the wrong side.

For power station work, an extra sheet of asbestos slate, carried on insulators, is fitted, with a view to preventing contact with the metal work of the door.

The Premier Electric Lamp Co., Ltd. (224).

The feature of this company's exhibit is the Premier metal-filament lamp, produced throughout at the Huyton Quarry factory, and suitable for pressures of from 20 to 250 volts.

In these lamps, the lower ends of the filaments are spring-supported, and the upper ends of each section are anchored; the makers claim that the lamps are exceedingly uniform in quality, and that they are not nearly so liable to breakage in transit as are some other such lamps.

They are shown burning in all positions, and we understand are giving the greatest satisfaction. The efficiencies range from ·8 watt per candle in the case of low-voltage lamps, to 1·2 watts for the 250-volt lamp.

MISCELLANEOUS EXHIBITS.

British Insulated and Helsby Cables, Ltd. (28).

The work done by the B.I. & H. Co. in connection with telegraphy and telephony is perhaps not so well known as that of their lighting and power cable manufacturing departments; it is, however, of very great extent. A number of cables are shown, of

B.I. & H. Drum-Indicator Switchboard.

various types, illustrating the several stages of manufacture, up to a lead-sheathed telephone cable of 800 pairs, 2⅝ in. in diameter. A 600-pair cable is shown with the ends opened out for testing. Telegraph cables are also exhibited, with screened conductors, and it is interesting to note that the company has introduced aluminium tape instead of copper for screening purposes, with great advantage; specimens of such cables, up to 3¾ in. diameter, are exhibited. The company is constructing cables for the underground telegraph trunk lines between Manchester and the surrounding centres of population.

Turning to the telephone apparatus, of which there is a large collection, we illustrate the front of a 50-line magneto drum-indicator switchboard, which is fitted with a new form of combined indicator and jack; the indicator is automatically restored on the insertion of a plug, and occupies an exceedingly small space, while it has no exposed parts and is dust proof. It is practically equivalent to a lamp, being but little larger, and is without the disadvantages attending the use of the latter. A 50-line standard test board is also shown, with various other patterns of board. An exhibit of special novelty and interest is the patent radial-arm wall or table set recently introduced by the company. In this device, while the plane of the transmitter is always vertical, and therefore in the most efficient position, the transmitter can be raised or lowered over a range of 6 in., to suit the height of the user. This is shown in one of the accompanying figures, and we may draw attention also to the metal case as an agreeable variation from the usual polished walnut. A breastplate transmitter and head set weighing only 6½ oz., complete with cord and band, is worthy of notice; and the common-battery table set which we illustrate has the advantage that the distance between the transmitter and the receiver can be adjusted to suit the user, a condition essential to the best results. A special patent transmitter is employed, which is not greatly affected by being used in the horizontal position. A selection of exchange apparatus, such as that used in the Cardiff exchange, which was recently equipped by the company, is shown; and bridging instruments for Canadian party lines are exhibited.

The telegraph apparatus is no less interesting. The company have lately been exporting much of this to take the place of American apparatus, to which their products are preferred. The patterns called for in this connection differ widely from those to which we are accustomed in this country.

Vyle's polarised sounder, which has come into extended use, is one of the prominent features of the exhibit. It can be worked on a long line, single or double current, simplex or duplex, without

Radial-Arm Wall Set.

relays or local batteries, and has for some time been successfully used on duplex underground circuits between London and Glasgow —a remarkable feat. The Kamm relay is also worthy of notice; it is shown used in various ways. For instance, a double-current repeater with Kamm relays, but without automatic switches—an entirely new design—is exhibited, as well as the closed-circuit type, with polarised sounders on the American model, and a single-current repeater board without relays, both of which are new types.

The Mansbridge patent condensers are made by the B.I. Co., fitted in metal cases with flush sides and ends, and occupying a remarkably small space for the capacity; and various other details of telephone and telegraph work are shown. Lastly, the Phantophone is exhibited for the first time: this apparatus permits of simultaneous telephony and telegraphy, over either single or double lines, and enables a telephone line to be superimposed upon existing telegraph lines. It is shown working under extraordinary

B.I. & H. Common-Battery Table Set.

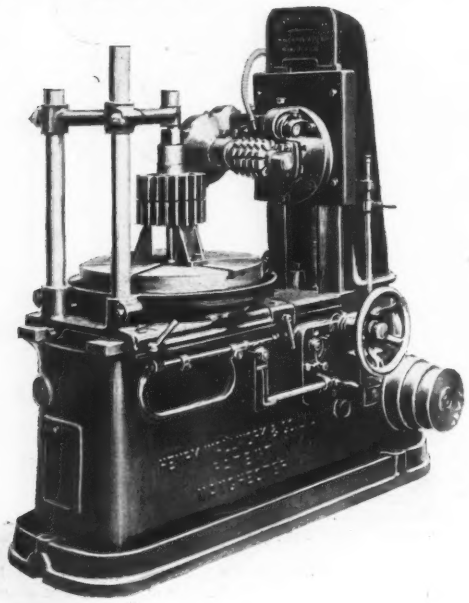
conditions—two instruments being bridged across two telegragh lines, one of which is working double-current duplex with Vyle's polarised sounders, and the other working with a single needle at one end, and a double-plate polarised sounder at the other. Each line is equivalent to 50 miles of aerial telegraph line, and on the two lines there are four lines of communication—three telegraph, and one telephone—all working simultaneously and independently.

Henry Wallwork & Co., Ltd. (42).

We illustrate herewith a gear hobbing machine manufactured by Messrs. Henry Wallwork & Co., Ltd., which generates with a hob the teeth of spur, right or left-hand spiral, and worm wheels. The form of tooth produced is generated by the rotation of the blank, and does not depend entirely on the accurate profile of the cutter. Only one hob is required for each pitch, and every gear cut has accurately formed teeth, independent of their number. Many other advantages are claimed for this method.

The machine is driven throughout by worm gear, with ball thrust collars fitting in oil-tight cases inside the frame; a silent, steady and powerful drive is thus obtained, only the change gear for driving the table and differential being placed on the outside for ease of manipulation.

The controlling levers have been brought together and placed in a most convenient position on one panel, the removal of which opens to view the whole of the driving and feed mechanism.



WALLWORK GEAR-HOBBING MACHINE.

The machine is driven by a three-speed cone pulley, which can easily be replaced by an electromotor when required.

A gear generating machine for cutting worm wheels of any pitch and any lead, up to 40 in. diameter, employing either a hob or a fly tool, is also shown. This machine depends for its action only on a correct selection of the change wheels from an easily worked formula supplied by the makers. No differential is employed.

A number of motors with reducing gear of 20 : 1 through worm gear, and one of 5 : 1 with raw-hide pinion, and cut spur wheel, are exhibited, together with a worm gear employed for the electric driving of a lead rolling mill, transmitting 96 H.P. with 90 per cent. efficiency.

The remaining exhibits are examples of malleable and other castings, resistance grids, &c., and patent universal electric lamp brackets of various patterns, suitable for workshop and office use.

T. W. Broadbent, Ltd. (31).

This is an exhibit of plant, &c., required for electric lighting and power transmission, from a three-phase motor to a switchboard; everything, with the exception of the lamps used for lighting, is of the firm's own manufacture. A three-phase motor is shown driving a continuous-current dynamo, the latter being used for the lighting of the stand. The motor is one of the firm's Standard N type. We understand that a special merit claimed is its massive mechanical design. The overall efficiency of the motor (which is rated at 7½ B.H.P. at 1,410 R.P.M, on a 400-volt 50-cycle circuit) is said to

BROADBENT "H" TYPE MOTOR-STARTER.

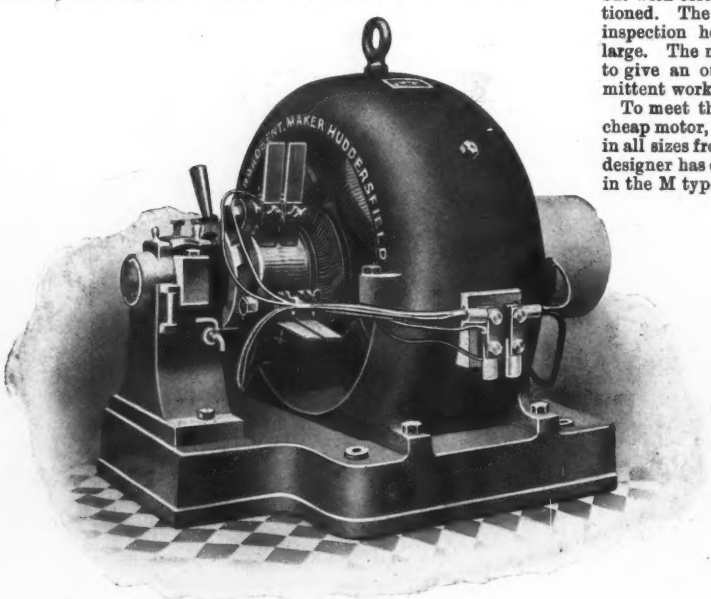
be about 77 per cent. at full load; and the full-load power factor 79 per cent. A "Leviathan" belt (made by Hebblethwaite Bros., Ltd., of Huddersfield, who are exhibiting jointly with Messrs. Broadbent) is used for driving the D 13 Broadbent dynamo.

In the design of the continuous-current machines considerable attention has been paid to the question of commutation. Like many other makers, the firm have, after experiment, adopted the box type of brush-holder (in which the brush slides in a brass box, the pressure being applied directly to the end of the brush) as their standard type for carbon brushes. There is a main switchboard, equipped with quick-break switches, which is used for the control of the lighting, &c. The board, which consists of two panels of enamelled slate, is of the class commonly used for small installations.

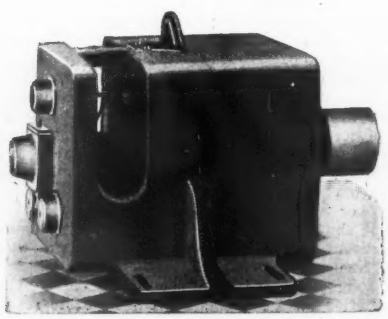
The motor-starter shown is of the H type enclosed, double-pole, comprising in one apparatus a double-pole switch, two main fuses, and a motor-starter with renewable contacts, and provided with adjustable no-voltage and overload release magnet, the whole enclosed in a light cast-iron case. This starter is designed to take the place of the customary motor panel; and it is operated by one motion of the handle.

The M type protected motor is electrically of a similar design, but with certain modifications, to the D type dynamo already mentioned. The brush gear is claimed to be easily accessible, the inspection holes in the end shield at the commutator end being large. The motor exhibited is of the M $\frac{3}{4}$ size, and is shunt wound to give an output of 9 B.H.P. at 560 R.P.M. at 110 volts, for intermittent work.

To meet the large demand among the smaller power-users for a cheap motor, a new line of small-power continuous-current motors in all sizes from ½ B.H.P. up to 1½ B.H.P., has been introduced. The designer has departed from the circular form of motor, as exemplified in the M type of motor, and has reverted in some degree to a more angular design. The C motors (see figure) are of a square section with rounded corners, as this form of construction requires, for a given winding on the magnet, the minimum of space and material. The firm also show a small steam generating set, the engine being by Messrs. E. Reader & Sons, Ltd., of Nottingham, and driving a small Broadbent dynamo.



BROADBENT BELT-DRIVEN DYNAMO.

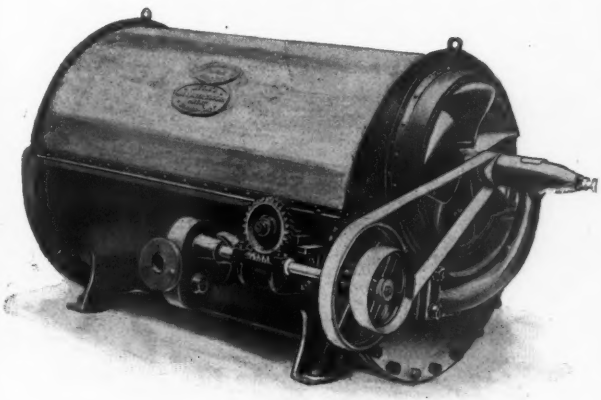


BROADBENT "C" TYPE MOTOR.

Heenan & Froude, Ltd. (153, 96).

This firm are exhibiting a detailed scale model of a Heenan patent destructor recently erected by them for the Wood Green U.D.C. The original plant is capable of dealing with 100 tons of refuse per 24 hours. The model serves to demonstrate the principle of the destructor and the utilisation of the hot gases under a steam boiler, this arrangement being, of course, very common at the present time.

Another interesting exhibit is a 6-ft. diameter mine ventilating fan, capable of exhausting 50,000 cb. ft. of air per minute against a pressure of 3 in. to 4 in. water gauge. Needless to say, this machine, which is driven by a 10-B H.P. motor, does not operate at its full capacity. The Froude patent water dynamometer and a



Air Cooler and Humidifier.

machine for cooling air, which we illustrate herewith, are also shown. The latter hails from "down under;" it is arranged to show the method of cooling circulating water for a gas engine. The plant occupies only 5 ft. 6 in. × 2 ft. 9 in. floor space, and will cool 500 gallons of water per hour from 130° F. to 70° F., this being sufficient for a 100-B.H.P. gas engine.

The apparatus is of interest especially in connection with the textile trades, as it can be utilised as a humidifier for supplying humidified air either heated or cooled as required.

Messrs. Heenan & Froude are placing this machine on the English market.

Siemens Bros. Dynamo Works, Ltd. (86, 97).

The company's stand leaves little to be desired in regard to variety and interest of exhibits. On one side is shown a calico loom running at 218 R.P.M., driven by a Siemens ½-B.H.P. 400-volt 50-cycle motor, which runs at 1,000 R.P.M. As the normal speed of the loom is 198 R.P.M., its satisfactory operation electrically at 218 R.P.M. is a matter for congratulation, although possibly not of surprise to electrical men.

On the opposite side of the stand to the loom another item of textile machinery claims attention. This is a gassing machine—obviously misnamed, since the operation of singeing the loose fibres off the thread, originally carried out with gas flames, is performed electrically in this case.

The arrangement adopted includes a small platinum channel, which is raised to white heat by means of a suitable current, and through which the thread is drawn at great speed.

A practical trial of these machines has demonstrated that they

Siemens Standard Induction Motor.

Crane Controller and Resistance.

save some 20 per cent. over the original type, and give a better product.

Alternating-current motors of the slip-ring and squirrel-cage types, also direct-current motors of various types are on view.

A small series motor, coupled to a 12½-in. fan, is fitted with a drum-type controller, arranged to give speed regulation by varying the grouping of the motor field-coils; independent overload and no-voltage releases, and a magnetic blow-out are fitted. As regards the fans, the table species figures in sizes from 8 in. to 14 in. diameter.

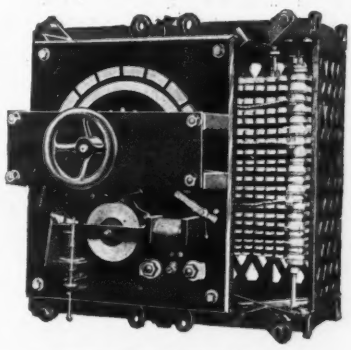
Among the switchgear on view may be mentioned 30-ampere single and triple-pole maximum and reverse-current circuit breakers, similar breakers for 700 amperes and 1,000 amperes; an oil immersed star-delta starter, and other standard types of starters.

One ingenious starter, which has only recently emerged from the company's works, is so arranged that the pulling round of the

Siemens Type "M A" Starter.

hand-wheel coils a heavy clock spring, and starts an escapement, which in turn operates mechanism for giving a slow starting movement over the contacts.

This is known as the Siemens fly-wheel starter; the mechanism, on coming into action, completes automatically all operations without further interference on the part of the attendant.



Siemens Fly-Wheel Starter.

A special feature is the step-by-step motion of the switch-arm, which moves sharply between contacts, but remains for a few seconds on the contact while the motor has time to accelerate. Since the exact time spent on the contact is known, the resistance can be so designed as to give uniform acceleration. Overload or failure of the supply causes the starter-arm to return automatically to the "off" position, and the switch-arm cannot be moved from the "off" position unless the main switch has been closed.

The company are showing a variety of their Economy and Liliput arc lamps, in various finishes, also specimens of the now well-known tantalum lamp, whole and dissected to illustrate the processes of manufacture.

First Garden City, Ltd. (155a).

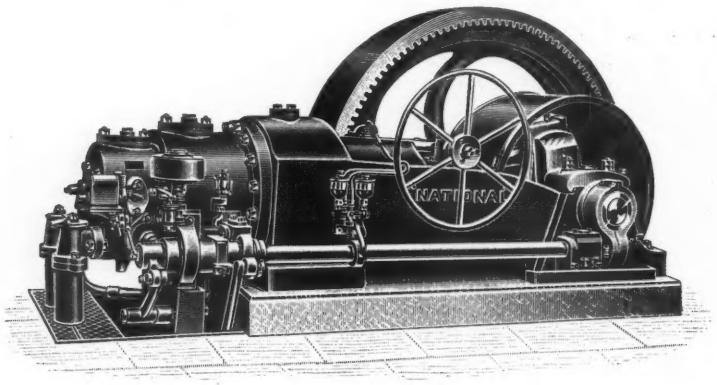
The Garden City at Letchworth, which came into being as the realisation of Mr. Ebenezer Howard's propaganda, has made remarkable progress during its four years' existence; the population is now 6,000, there are 1,100 houses and 24 factories built or building, and 8 miles of new roads have been made. The object of the promoters in exhibiting at Manchester is to draw attention to the facilities for industry that are offered by their city; apart from the social and hygienic advantages resulting from the economic principles of organisation adopted and the healthy situation chosen, there are special inducements for manufacturers to settle there in the shape of low rates (2s 2d. in the pound), low rents, good railway facilities and easy access to London, cheap gas and electric power, sound foundations, and contented labour.

What more could be desired?

The National Gas Engine Co., Ltd. (271).

The company are showing one of their new model "Y E" type engines, rated at some 100 H.P., which operates on suction gas, supplied from one of the company's "Gold Medal" type producers. This engine is designed for mill driving or electric light work, and appears to be a particularly easy and quiet running machine. It is fitted with ring lubrication on the main bearings, throttle governing, electric ignition and compressed-air starting.

A combined electric lighting set, incorporating an "M E" type engine and dynamo, and running on town's gas, is also shown in operation.



THE NATIONAL CO.'S "Y E" TYPE GAS ENGINE.

The Rapid Magnetting Machine Co., Ltd. (235).

This company are, we believe, alone in showing magnetic separators, several useful types of this machine being shown at work.

Of these, the type B machine is suitable for treating all kinds of dry material containing iron in small percentage, as, for instance, metal borings and small scrap, ground bones, charcoal, dry clay, corn, ground flint, glass, grain, rubber, &c.

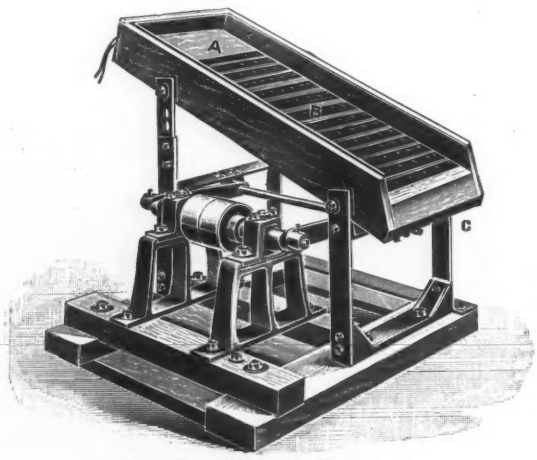
Roughly described, it consists of a shoot or tray, oscillating sideways about 250 times per minute by means of a reciprocating motion in a similar manner to a sieving machine.

This shoot is built up of a series of very powerful electric magnets extending across the full width.

By means of the reciprocating motion, the material is shaken and rolled down the shoot, the iron being seized by the electro-magnets and retained. With a type "B" separator 5 ft. in length, the material has to pass over about 25 electro-magnets, which is equal to passing it over a drum type separator 25 times.

To remove the iron it is only necessary to occasionally stop the machine, switch off the current and clear the tray.

The makers call special attention to the fact that the material does not pass between magnets, but over them, and therefore the iron would have to jump a series of magnetic hurdles, figuratively speaking, before it could pass off the shoot along with the treated material.



TYPE "B" MAGNETIC SEPARATOR.

For dealing with potters' slip, glaze, &c., a similar machine to the above is supplied; the trough, however, has no motion, and its magnets have a number of upward projections for breaking the flow of the liquid; from the lower end of the trough the liquid flows over a short bridge, held in place magnetically, and which collapses in such a way as to divert the flow, if the magnet circuits fail through any cause—otherwise the whole of the iron particles on the magnets would be carried over into the ark containing cleaned liquid.

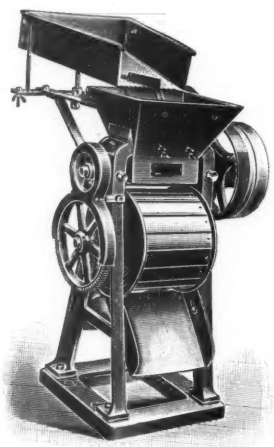
The trough is given a fall of 4 or 5 in. to the foot, so as to ensure a shallow quick flow and constant frictional contact with the magnets.

The latter, being electro-magnets, can be easily washed clean when de-energised, this being a considerable advantage as compared with permanent magnets.

In order that current failures may be quickly attended to, an electric bell is provided to draw attention to any defect in the circuit.

A standard separator is also shown, this being the type of machine used in the Birmingham district for separating purposes, where it has proved its ability to deal with mixtures of 99 per cent. iron and 1 per cent. brass.

The material is automatically fed from a shaking hopper in a constant stream on to a revolving brass drum, inside which, radiating from the centre, are stationary electro-magnets. The magnetic field extends round one-half of the drum. On coming in contact, the iron is held by the magnets, and by means of the ridges on the revolving drum, is carried round to the back of the machine and out of the magnetic field, when it falls immediately by gravity.



STANDARD MAGNETIC SEPARATOR, FOR IRON-BRASS MIXTURES.

Whilst revolving, the iron jumps from magnet to magnet thus releasing every particle of non-magnetic material, which falls by gravity in front.

Another type of machine illustrated, type A, is specially designed for removing iron from refuse destructor slag in order to improve the latter for mortar, concrete slab making, &c.

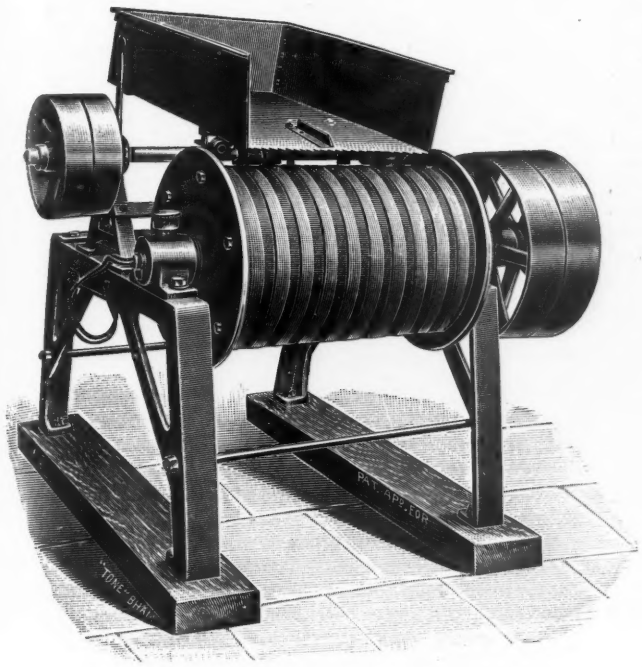
This machine also consists of an electro-magnetic revolving drum, on to which the crushed clinker is fed in a regular stream either by means of the shaker feed shown or other means most convenient. The iron is immediately seized by the electro-magnets, and carried to the back, where it leaves the drum, falling into a suitable receptacle. The clinker, having no affinity for the electro-magnets, falls off in front as fast as fed on.

This machine has been adopted for the purpose indicated by one of the largest Corporations in the kingdom.

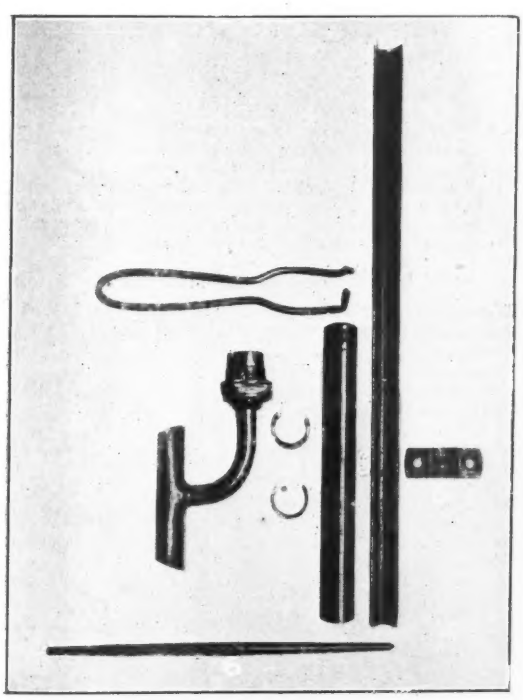
Dr. Heinrich Traun & Sons (192).

Messrs. Traun's work in ebonite and vulcanite is too well known to need a lengthy reference. Needless to add, the stand is fully representative of the very wide range of products associated with the firm, including motor-car, battery, telephone and laboratory specialities, many of them of most intricate design, bearing

evidence of very skilful moulding. Some tramway link strains which we were shown, absolutely defied hammering, and, we understand, only broke down, when tested electrically, at 45,000 volts, and then by arcing between metal parts, no breakdown occurring at the insulated joints.



Rapid Magnetting Machine Co.'s Crushed Clinker Separator.



1, Key for removing fittings from conduit; 2, Spring for clipping conduits to wall brackets; 3, Conduit, cover and troughing; 4, Bracket lamp constructed to spring on to conduits; 5, Wall bracket for fixing conduits to walls, &c.; 6, Tool for removing cover from conduit.

Key Spring Conduit and Fittings Unassembled.

In this connection it is important to note that the firm produce many grades of insulation, and will supply special material of great mechanical or electrical strength, or for heat resisting purposes or frictional work as may be required. We noted a small ebonite centrifugal pump, specially designed for acid pumping, and the firm supply ebonite pipes, flanges, tees, cocks, &c., suitable for this class of work.

Key Engineering Co., Ltd. (281).

The Key Fibre Conduit, which has become very popular amongst mains engineers during recent years, is naturally a prominent feature of this firm's exhibit; samples of such conduit intended to

Conduit and Fittings Assembled.

carry corrosive liquids at high pressures are shown, as well as fibre conduit for cables, illustrating its flexibility, durability, lightness, and inherent strength. Lead-covered cable laid in fibre conduit for a long period, and withdrawn undamaged, is compared with a similar length which had been laid in stoneware, the lead sheathing of the latter being eaten entirely through in parts; and a piece of fibre conduit is kept in boiling water to show that it is unaffected by high temperature and moisture. The Reavell air compressor, previously described, is exhibited on this stand, and a large gas-engine exhaust valve, which has been at work for 18 months in an Ehrhardt & Sehmer gas engine of 2,000 H.P., is exhibited to show that the present practice of cooling these valves with water is quite unnecessary.

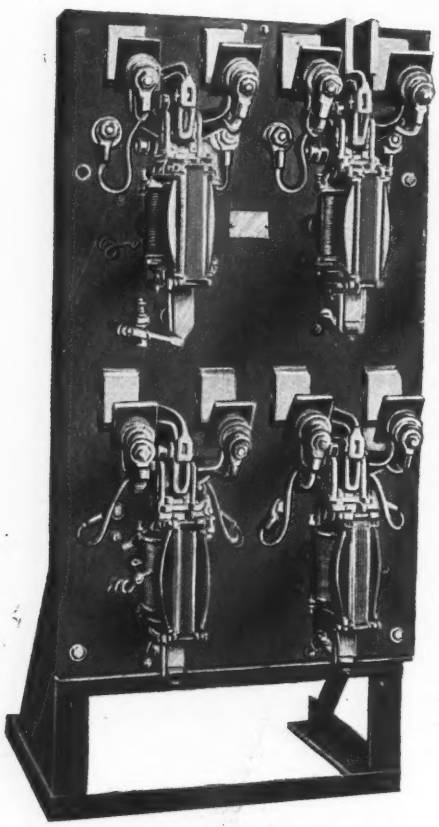
The principal novelty that the company is bringing forward is the Key Spring conduit; this is a steel trough, with a similar cover which is sprung upon it, and holds firmly without other aid. The accompanying illustrations show the conduit and accessories; the latter consist of springs for attaching the conduit to wall brackets, bracket lamps which can be sprung on to conduits, &c. The great advantage of this system is the rapidity and cheapness with which it can be erected; the wires can be laid in the troughing without the troublesome and damaging process of pulling through, and all switches, fittings, &c., can be wired before putting the wires in place in the conduit. Bonding is, of course, automatic, and the whole process of erection is immensely simplified, while the wiring is at all times accessible, and alterations can be made with ease. Smaller conduits also can be employed, as pulling through is obviated. To demonstrate the facility with which installations can be carried out when Key Spring conduit is used, a circuit consisting of a switch, bracket lamp, three-light ceiling fitting, pendant fitting, and 20 ft. of steel conduit, is erected complete in $4\frac{3}{4}$ minutes from the start (the fittings being, of course, ready wired). Ample protection is obtained for the wiring, and the system offers advantages known to no other system of conduits.

Thomas H. Mealey (203).

The principal thing of electrical interest that is to be found on this stand is the Tress mercury-vapour portrait lamp, which is made by the Tress Co., of London, whom Mr. Mealey is representing. Photographs are being taken with the aid of the light of this lamp during the run of the Exhibition. The lamp consists of three exhausted cylindrical glass tubes, about $\frac{7}{8}$ in. dia. × 26 in. long, into the ends of which platinum wires are fused, which terminate in carbon blocks inside the tube. The tubes contain about $9\frac{1}{2}$ oz. of mercury, and the lamp is lit by the tilting of the tubes. In a small catalogue issued, the application of the lamp to a printing cabinet is shown, with which a P.O.P. print is made in approximately 15 minutes, the cost of current being 1d. per hour, reckoning 2d. per unit. The firm also does business in electric flat-irons for dry-print mounting.

Electric Control, Ltd. (159, 135).

This firm is exhibiting through its agents, Messrs. Parmiter, Hope & Sugden. The main feature of the exhibit is the "Empire" automatic starter for polyphase induction motors, which consists of a series of D.P. switches actuated by solenoids. On closing the control circuit, the first solenoid switch becomes energised and closes the primary circuit of the motor, all the resistance being in the rotor circuit; after an appropriate interval, which can be regulated as desired, the second solenoid is energised and short-circuits part of the resistance in the rotor circuit. This process is automatically repeated until the last solenoid switch short-circuits all the resistance and open-circuits all the intermediate solenoids, allowing them to fall open. This starter has no sliding contacts, the contact parts being made of carbon, with quick make and break. The circuit is never broken, except on the first contact, where the arc is quietly extinguished. On failure of the power supply, all the switches open, thus putting in all the resistance, and opening



"EMPIRE" AUTOMATIC A.C. STARTER.

the main circuit; but if the control switch is not opened, the motor will automatically start up again when the supply is renewed. These starters are made either open, ventilated enclosed, or totally enclosed.

The "Empire" starter for D.C. motors consists of a single solenoid with plunger and dashpot, actuating a number of levers hinged to the lower pole-piece of the solenoid; when the circuit through the solenoid is closed, the plunger rises slowly, and releases the levers in succession, which are attracted by the solenoidal field and make contacts which cut out the resistance, the last of all short-circuiting the resistances. When the switch is fully closed, a resistance is inserted in series with the main solenoid, to reduce the loss of power in the latter. The apparatus has already been fully described in our pages.

G. R. Peers (150).

On this stand are shown a handy portable (folding) electric light bath suitable for home use, and smaller apparatus of a similar kind for treating limbs, &c., also an ingenious electrical vibrator. The importance of the electric light bath treatment for many kinds of disease cannot be over-estimated, and practically the same applies to the use of the vibrator for massage treatment.

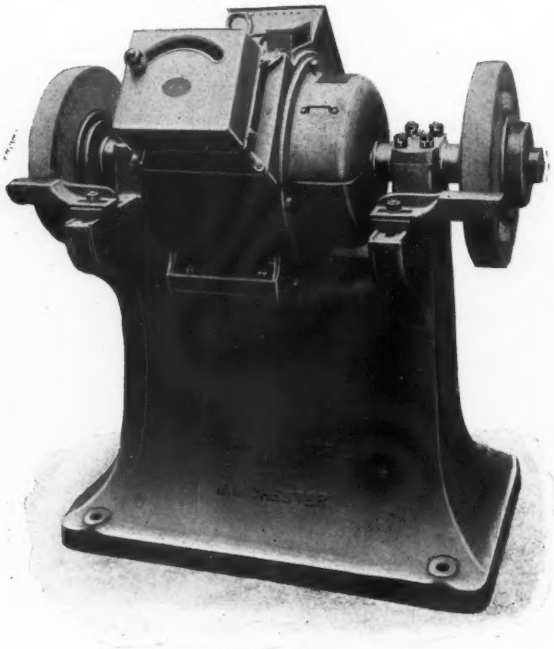
The electric vibrator shown by Mr. Peers is an exceedingly handy appliance, available for either direct or alternating-current circuits (the latter between 30 and 100 cycles) on to which it can be plugged at any lamp-holder.

The vibrating hand does not revolve—the motion being a tapping one—and the vibrations can be varied over a wide range.

Luke & Spencer, Ltd. (43, 44).

The firm's stand is fully representative of their numerous specialities in grinding and polishing machinery. These machines practically cover all requirements, and are in suitable cases incorporated with a motor drive.

Through the kindness of the firm, we are enabled to illustrate one of these electrically-driven grinding machines, which consists of a stand with extra long bearings carrying a steel spindle, ground



ELECTRICALLY-DRIVEN GRINDER.

perfectly true and provided with right and left-hand nuts to hold the emery wheels in place. The emery wheels are each 18 in. in diameter × 2½ in. thick, mounted on improved safety dove-tail plates. The plates carrying the wheels on this machine are also fitted with patent safety covers; the spindle is arranged to run in self-oiling ring bearings, and is fitted with a motor of 7 B.H.P. arranged to run at 1,000 R.P.M.; and a field rheostat is provided by which the speed can be increased to 1,500 R.P.M. as the wheels wear down. The rheostat is enclosed in a square cast-iron box with a loose lid, and a completely enclosed terminal box and starting switch, with automatic no-load and overload release, is provided.

The motor is shunt-wound for 440 volts D.C.

International Electric Co. (191).

This company restricts its exhibit to novelties only, in the belief that its manufactures generally are too well-known to require

FIRE-ALARM CALL-BOX.

"showing-off" at the Exhibition. For colliery and mining purposes specially constructed watertight telephone instruments are shown, and a variety of gas-proof signalling bells, which, it is claimed, even in mines where fire-damp occurs, can be used

with absolute safety. For the naval architect, and for shipbuilders, the company shows its naval type, loud-speaking telephones, for which solid construction, substantial mounting, and efficient working are claimed. We understand that the transmission of the loud-speaking telephone is sufficiently clear to be heard even in the noisy engine room, and we illustrate such a loud-speaker as provided for the captain's cabin. The company's new system of hotel and cabin service, as installed in some of the most up-to-date hotels, and on board the latest type of passenger steamer, avoids disturbances due to the continuous ringing of the indicator bell. The International's system employs signalling by means of light. A coloured light in the pantry of a steamer, or the service room of an hotel, shows the attendant whence the call emanates; a similarly coloured lamp lights up in the corridor, and a white light is shown outside the

Loud-Speaking Naval Telephone.

cabin, or the visitors' room. On attending to the call the steward presses a push outside the caller's cabin, extinguishing the three lamps concerned, and re-establishing the normal condition. It is claimed that signalling by light is preferable to the old method; in infirmaries, hospitals, &c., it will be found equally serviceable, and as the lamps used in connection therewith are of the low-voltage battery type, the cost of upkeep is very moderate. A street fire-alarm call-post, in which the loud-speaking telephone is made use of, is intended to reduce effectively the number of false alarms. When on breaking the glass a call is made, the door of the fire-alarm post opens automatically, and the central station immediately calls out by means of the loud-speaking telephone, "Where is the fire?" As passers-by will hear this, it is obvious that a mischievous person giving a false alarm could be caught in no time. Telephonic conversation can be carried on between the fire-alarm post and the fire station. Special test pushes are provided, thus allowing the supervision of the line, without interfering with the ordinary working of the system. Amongst a large number of electricity meters for direct, alternating and polyphase currents, the firm show a two-tariff meter, which should interest central-station engineers. Their "Orieco" metallic-filament lamps are shown also; an automatic arrangement, switching off and on every five seconds a number of "Orieco" metallic-filament lamps, illuminates a novel advertising design, by means of which they call attention to the advantages that the use of the "Orieco" lamp offers.

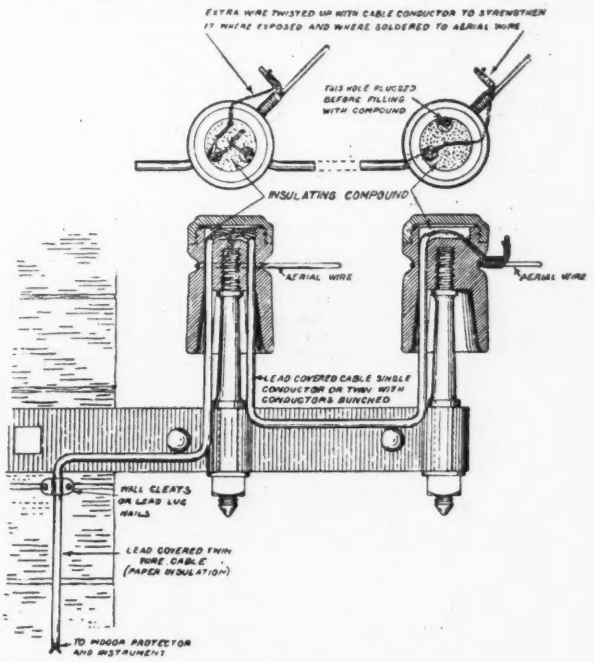
Taylor, Tunnicliff & Co., Ltd. (63).

To those who are interested in English electrical porcelain, Messrs. Taylor, Tunnicliff's exhibit will be thrice welcome. The various show-cases contain practically everything which the electrical engineer can require in this particular line.

A prominent example is a four-part H.T. insulator 21 in. in diameter and 2 ft. 5 in. high, designed for testing purposes for a pressure of 200,000 volts; similar insulators for 100,000 volts and under are shown. We can only mention the great variety of small moulded porcelains shown—these, in many cases, being of a very intricate character, such as, for instance, a 40-fuse bridge, which we examined. The firm are, however, prepared to deal with anything of this nature, their strong feature being the production of the special tools required in this work.

Examples of the brown glazed insulators, of which some 1,200 were supplied for the Midland Railway single-phase section, are shown. These were subjected to a 26,000-volt test, without a single failure.

An interesting feature is the patent pot-head insulator for use when leading-in telephone or telegraph wires into buildings. This


EXTRA WIRE TWISTED UP WITH CABLE CONDUCTOR TO STRENGTHEN IT WHERE EXPOSED AND WHERE SOLDERED TO AERIAL WIRE
THIS HOLE PLUGGED BEFORE FILLING WITH COMPOUND
INSULATING COMPOUND
AERIAL WIRE
AERIAL WIRE
LEAD COVERED CABLE SINGLE CONDUCTOR OR TWIN WITH CONDUCTORS BUNCHED
WALL CLEATS OR LEAD LUG NAILS
LEAD COVERED TWIN WIRE CABLE (PAPER INSULATION)
TO INDOOR PROTECTOR AND INSTRUMENT

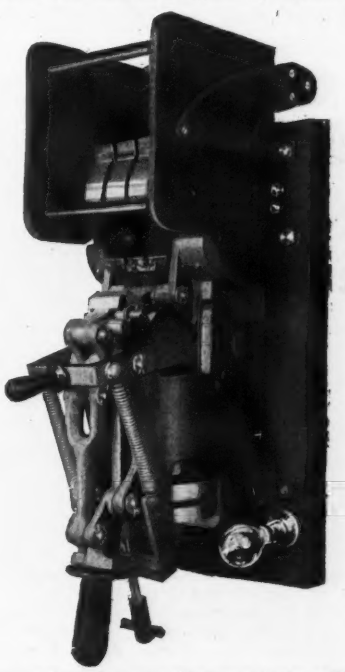
Taylor, Tunnicliff Leading-in System.

insulator is provided with a screwed cap, which is removed for threading the lead-covered twin wire leading-in cable from underneath (see illustration). This leading-in cable is stripped to the point where it emerges into the cavity under the cap, one wire being passed through a small hole in the insulator to connect to the line wire, and the other being connected to a second short length of lead-covered cable which passes down through the first insulator and up into the second to connect to the second line wire.

The spare hole in the second insulator is plugged with waste, and the cavities are in each case filled with insulating compound prior to screwing on the caps. The above method would be employed in the case of a telephone circuit. The system has been adopted by the British Post Office and leading railway companies, and is claimed to be the cheapest and most efficient method of doing this class of work.

Eckstein, Heap & Co. (84).

The exhibit of Messrs. Eckstein, Heap & Co. consists mainly of switchgear, of all sorts and sizes, apparently capable of meeting all



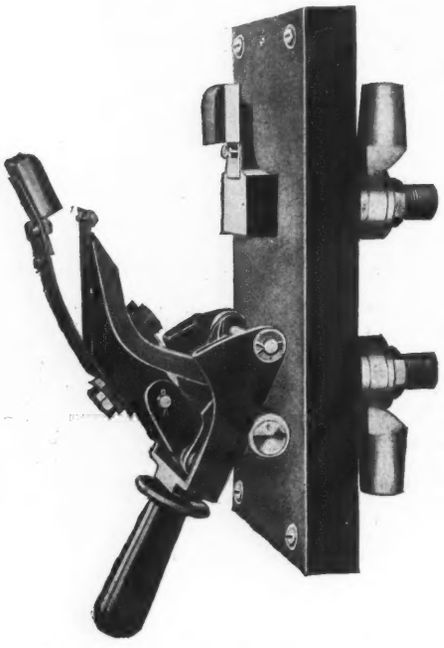
Eckstein, Heap Reverse-Current Circuit-Breaker.

possible requirements, and possessing features of exceptional merit. Amid so great a variety it is difficult to make a selection.

Circuit-breakers are, perhaps, the most noteworthy features of the exhibit; these are shown for direct current, from 50 to 2,000 amperes, of the loose-handle type, with renewable copper sparking fingers, carbon breaking pieces, and magnetic blow-outs; they are also provided with releases for overload, no-volt, reverse-current, and combinations of these. Special features of these breakers are the long break and the patented loose-handle device—the latter being obtained by means of a double-toggle motion passing over its dead centre, which is broken at the knuckle by the automatic releases. This arrangement is self-resetting, and works with great efficiency. We illustrate a reverse current circuit-breaker of this type on the previous page. This has a separate clapper which is closed by hand. The ingenious use of an amortisseur coil ensures that the switch cannot remain closed when a sudden heavy reverse current flows.

The "Waverley" knife switches for 15 to 3,000 amperes, single, double and triple-pole, form another long range of exhibits. The distinguishing feature of these is the frame, rigidly supported, which carries the main current-carrying blades; the latter are ground into the contacts, and never move, so that they cannot get out of alignment. A light flicker blade gives a quick-break action; no current passes through the hinge.

Next come porcelain handle fuses, from 15 to 750 amperes, in which the fuse wire does not pass through the fuse handle, but



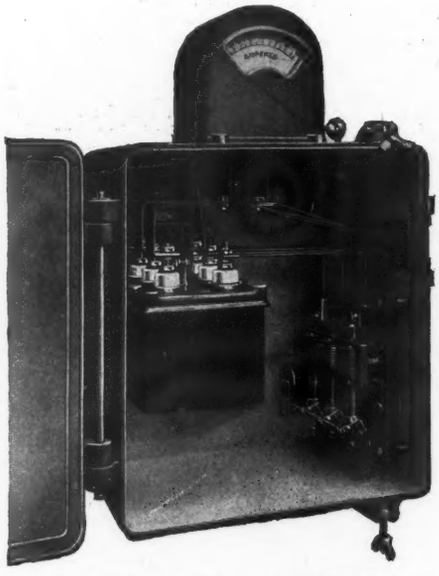
ECKSTEIN, HEAP BRUSH CONTACT SWITCH.

through tubes mounted on the contact blocks, which are fixed separately to the porcelain base; thus the handle does not get hot. For sizes above 150 amperes, each wire passes through a separate tube, no wire carrying over 150 amperes.

Many other items of D.C. switchgear, such as brush contact switches with renewable copper sparking fingers and carbon breaks (see figure), cast-iron enclosed switches, &c., might be described if space allowed.

The alternating-current switchgear, while it embodies some of the features of the D.C. apparatus, is still of great interest, having several characteristics of its own. All of the A.C. switches are of the oil-break type, mainly for three-phase currents, with automatic tripping devices. The same ingenious toggle mechanism is here made use of as in the D.C. circuit-breakers. One of the hand-operated switches has a carrying capacity of 200 amperes per phase at 10,000 volts, with overload release on each phase; most of the switches, however, are intended for pressures up to 600 volts, some being of the remote control type, and having various combinations of automatic releases. A large variety of them is shown on the switchboards at the back of the stand.

Apart from the foregoing, there is a collection of ironclad switchgear for colliery use, on which much could be said. We illustrate an enclosed remote-controlled three-phase switch of this type provided with automatic "no-voltage" release, and overload release on three phases. The latter device is fitted with the firm's patent retarding arrangement. As is well known, alternating-current motors take a large current when starting. If the overload tripping devices were set so as to protect the motor against normal overloads of, say, 25 per cent., it would be impossible to keep the oil switch closed when starting, owing to the large current that was passing. To overcome this difficulty, Messrs. Eckstein, Heap & Co. have developed an arrangement such that, during the time the motor is starting up, and therefore taking a large current, the tripping devices require four to five times the full-load current to operate them. When the motor has got up to speed, and therefore is taking the normal running current, the tripping devices are

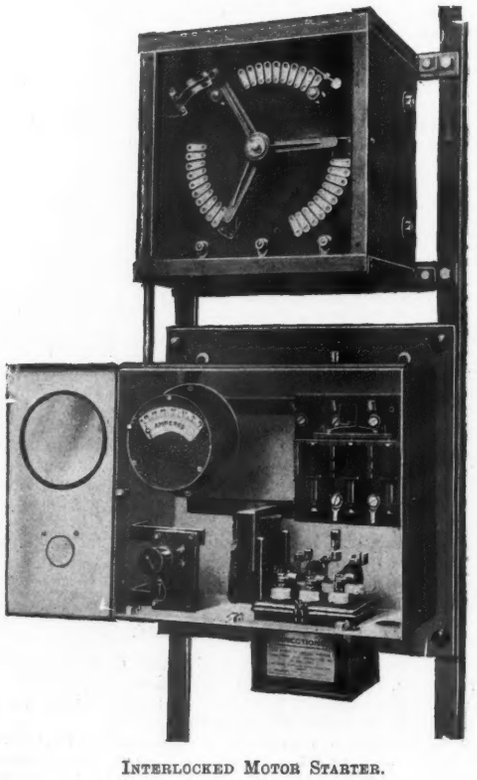


ENCLOSED REMOTE-CONTROL THREE-PHASE OIL-BREAK SWITCH.

automatically set to trip the oil switch when the overload exceeds, say, 25 per cent. of normal full load.

Another view shows a three-phase motor-starting panel, for use with a slip-ring motor; the rotor rheostat and the main oil switch are electrically interlocked, so that the oil switch cannot be closed unless the starter is in the correct position, and the oil-break switch is provided with an automatic no-voltage release, and overload release on three phases.

We have by no means exhausted the interesting features of this exhibit. Service fuse boxes, in which the fittings can be wired outside the case; watertight fuse and distributing boxes; enclosed



INTERLOCKED MOTOR STARTER.

circuit-breakers, and water and gas-tight switchgear; examples of the high-pressure switchgear supplied to the Manchester Corporation sub-stations; self-contained colliery switch-panels, &c., are shown in great variety.

The Diesel Engine Co., Ltd. (261).

The Diesel Co. are exhibiting a two-cylinder 100-B.H.P. engine, running at 190 B.P.M. direct coupled to a Westinghouse D.C. 220-volt generator.

To illustrate the exactness of the manufacture of engines sold by this company, it is interesting to note that the Exhibition engine had never been run before its erection at Manchester, and everything has worked with smoothness from the very commencement.

The consumption of oil at full load is guaranteed not to exceed 0·44 lb. per B.H.P.-hour, whilst in larger sizes 0·4 lb. is guaranteed. One of the well-known features of this engine is the extreme economy at light loads, at half load the guaranteed figures are 0·52 lb. and 0·47 lb. per B.H.P.-hour respectively for small and large sizes.

The Diesel Engine Company's Exhibit.

These figures relate to any class of oil having a calorific value of not less than 18,000 B.TH.U.'s per lb., and the engine is so arranged that without alteration, cheap petroleum residues—costing in various parts of the world from 40s. to 60s. per ton—can be used equally well.

The cost for fuel is thus only slightly over 0·2d. per unit, and this figure is actually obtained at many of the stations where the Diesel engine is in use.

The engine can be started up in 45 seconds to take full load. The company have, amongst other contracts, supplied a most successful plant for the Calcutta Tramway Co., and although coal can be purchased there at 10s. per ton, the results obtained by the Diesel engine have been to reduce the cost of fuel per car-mile from 0·6d. to 0·27d., thus showing an enormous saving.

They have also supplied a plant consisting of 3,000 H.P. for the Vera Cruz Tramway Power and Lighting Co., and have now in hand an order for 5,000 B.H.P. for the Charing Cross, West End and City Electric Supply Co. The engineer of this company, in his evidence on the London Power Bill, stated that he was installing Diesel engines because he found that after allowing 8 per cent. on the capital cost, he could generate at 0·367d. per unit.

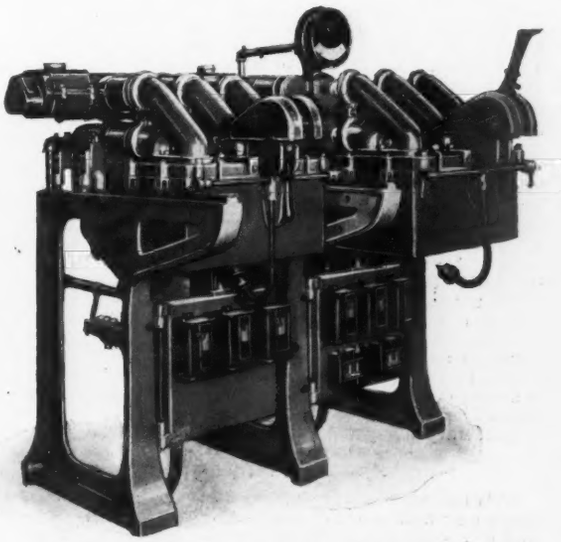
The Diesel Co. are now building engines in sizes from 20 B.H.P. to 1,500 B.H.P., both for marine and stationary purposes.

A. Reyrolle & Co. (95).

The principal feature of Messrs. Reyrolle's exhibit is the ironclad switchgear which they have developed, on lines differing entirely from any previous designs. We have recently fully described this apparatus, and therefore we need only draw attention to the chief points claimed for it. The gear is completely enclosed and fire-proof, and needs no cleaning—an important advantage; the live conductors are embedded in insulating compound, so that no deterioration of the insulation can take place, while all the parts that require inspection can be easily isolated and examined by one man. Simplicity and safety are essential features of the design; the switchgear cannot be closed or opened when the switch is in the closed position, and the lever which is used for racking out the carriage breaks the control circuit before it can be employed for this purpose. The switch cannot be closed without restoring this lever to its place. When the carriage is withdrawn, the live contacts are automatically covered with cast-iron shutters, so that they are absolutely invisible and inaccessible.

The accompanying illustration shows the standard 6,000-volt, 2,000-KW. transformer and feeder panels exhibited, the latter being identical with those installed on the Newcastle Electric Supply Co.'s circuits; both are fitted with the Merz-Price relays, but can be used with any other system of protection.

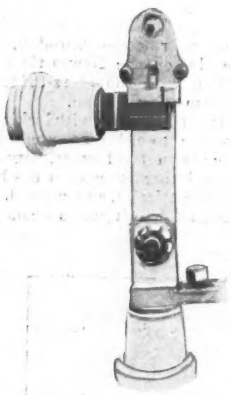
Another view shows an isolating switch with locking caps specially designed by Messrs. Reyrolle to fulfil an unusual requirement. When, owing to short circuits on the feeders, very heavy currents pass through the blades of isolating switches, it has been found that the blades are blown out automatically, and when this occurs a huge arc is set up on the switchboard which causes a complete shut-down of the generating plant. The cap shown in the view is operated by the ordinary hook; when the switch is closed, the cap drops over the fixed contacts and fits over the curved edge of the latter, and



Reyrolle Ironclad Switchgear, Closed and Open.

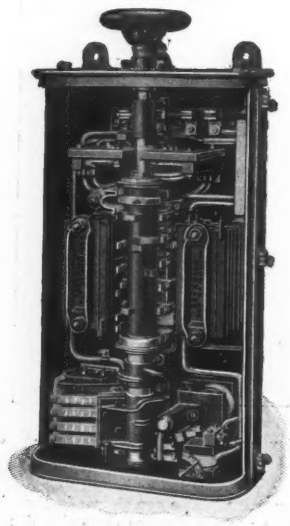
thereby prevents the possibility of the blade being withdrawn until the cap is lifted by the isolating switch hook.

Other exhibits relate largely to the Reyrolle motor starters, which are distinguished by the use of a special patent graphite and iron resistance, with a negative temperature resistance coefficient. The starting lever being placed on the first stop is left there, the



INSULATING SWITCH, WITH LOCKING CAP.

current increasing at first until the back E.M.F. of the motor begins to take effect, after which it remains nearly constant while the motor gains speed; the resistance is then cut out in steps. This resistance is used on all the Reyrolle starters. Both lever and drum type starters are exhibited, the latter being of special interest,



REYROLLE DRUM-TYPE MOTOR STARTER.

as the handle makes two revolutions; the first turn starts the motor, while the second operates the shunt regulator. We illustrate a drum controller suitable for a printing press. Several starters are shown in connection with a motor running on a brake load; and colliery switchgear is also exhibited.

Mountain & Gibson, Ltd. (56, 57, 58).

This firm are showing specimens of their centre-bearing swing-bolster maximum-traction and equal-wheel trucks, both of which have been adopted on numerous tramway undertakings. As regards the former type, the L.C.C. have, during the past two years, placed orders for similar trucks for some 750 cars, and the last-named truck, which embodies built-up steel side frames and is specially suitable for interurban express service, is one of a number built for the Montreal Street Railway Co.

"M.G." trolley standards for double and single-deckers or top-covered cars, with internal and external springs, Whittaker's sand gear and Wilson's patent steel rolling doors and shutters, are also shown on the stand.

The sanding gear is claimed to possess several advantageous features; the hopper is non-choking, and an efficient means of regulating the flow of the sand is provided.

Another speciality shown is the E.P.D. earthing indicator.

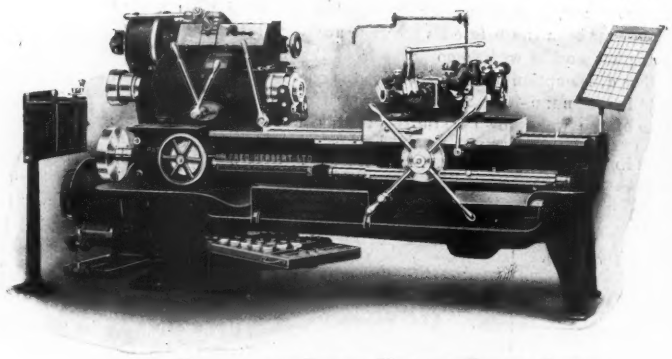
Mica Plate Co. (107a, 108a).

This firm are showing an assortment of insulating materials, including "flexible mica," which can be made in sheets 6 ft. × 5 ft., and up to 4 mm. in thickness, with a dielectric strength of 800 volts per mm. Oiled linen bias tape, oiled linen sheets with mica between for slot insulation, Berrite insulating fabric, and all sorts of mica fittings, washers, tubes, &c., of pure mica or mica and paper, are shown. One of the novel items is a sparking plug of pure mica.

Alfred Herbert, Ltd. (87, 96).

Messrs. Herbert's stand contains a number of interesting machine tools, including lathes, milling and drilling machines.

We illustrate a patent hexagon turret lathe, driven by a motor placed on the floor and connected up by a belt drive.



ELECTRICALLY-DRIVEN HEXAGON TURRET LATHE.

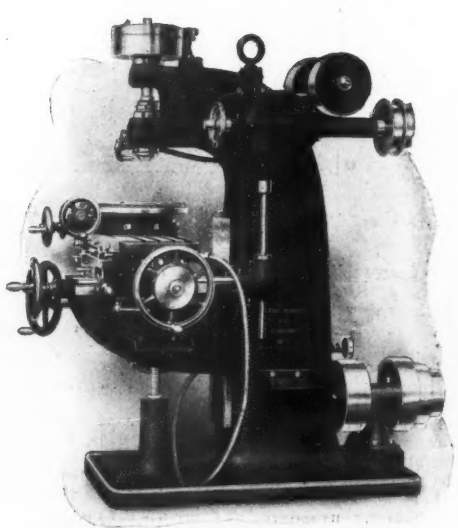
The motor is of the constant speed type, the 16 changes of spindle speed in either direction being obtained mechanically in the machine itself by means of the "Herbert" single pulley head.

It will be noticed that the application of the direct electric drive is of the simplest form; any size or type of constant-speed motor may be used, and no special work is required.

The lathe is shown making heavy reductions in diameter at high speeds and with coarse feeds.

The advent of the "Herbert" patent roller steady turning tool has enabled an enormous increase in output to be obtained, and renders the production of work direct from the bar still more economical than turning up forgings between centres.

The turret lathe shown will admit bars up to 2¼ in. in diameter, and has a working stroke to the turret of 30 in. in length. One of its special features is the great rapidity with which chuck jaws and screwing dies are changed and the tools adjusted for dealing with different diameters and lengths of work; this



HERBERT VERTICAL MILLING MACHINE.

enables the machine to be used for making even a small number of articles, say two or three at each setting of the tools, with economy.

We also illustrate a vertical milling machine. This machine has a patent dial feed motion, and it is placed in a very convenient position, being in front of the operator.

The machine is of very compact design and great power, and is capable of taking heavy cuts at quick feeds.

The driving is by long belt and spur gearing, no bevels being employed. This enables small diameter end mills to run at very high speeds without any jar or chatter.

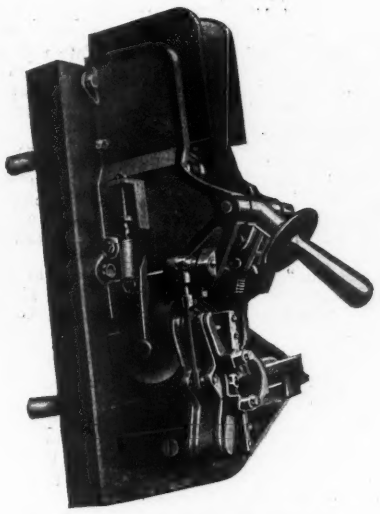
A horizontal milling machine and a patent ball-bearing sensitive drilling machine are also worthy of notice.

Lyle Trading and Manufacturing Co., Ltd. (123).

An electrical engineers' exhibition without modern card index systems would have been a quite incomplete affair. This company are present with their Lyle-Dossier filing and card index systems, patent ledgers, individual file and catalogue covers, and other specialities.

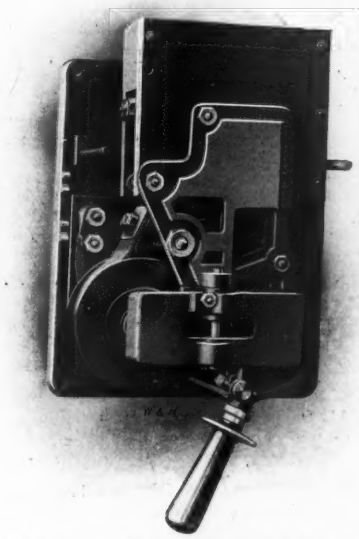
Whipp & Bourne (77).

The special features of this exhibit are circuit-breakers. These are shown in great variety, with overload, reverse, no-volt, &c., attachments, singly or together, and coupled in various ways. A specially small breaker for house-service use is particularly neat, carrying 50 amperes at any pressure up to 600 volts, and having a base of only 6 × 3½ in. The reverse-current circuit-breaker, which we



Reverse-Current Circuit-Breaker.

illustrate, is shown under various conditions of load, demonstrating the impossibility of its remaining closed with a reverse current; even when the polarising circuit is actually interrupted, the breaker opens with a reverse current, thanks to the provision of a residual magnetic field. All the breakers are of the loose-handle type, with magnetic blow-out; no auxiliary fingers are employed to energise the blow-out coil, and the main brush is placed in a strong magnetic field, though sparking pieces are always provided. The release mechanism is actuated by a force proportional to the current, and does not depend on a spring or on a hammer blow; there is no sliding core in a solenoid, and the reverse-current breaker cannot be opened by a forward current of any magnitude whatever. The



Interior of Car Hood Circuit-Breaker.

compactness and accessibility of these circuit-breakers are especially noteworthy features, and they are of substantial design and reliable in operation. A tramcar hood circuit-breaker, which we illustrate, is worthy of note; it is both opened and closed by the handle, but cannot be closed on an overload, and is provided with magnetic blow-out. It will not open through vibration.

Time-lag circuit-breakers are exhibited, which are self-resetting; in the case of a succession of moderate overloads, the switch will not open unless the overloads occur at very short intervals. A seconds scale for calibration is provided.

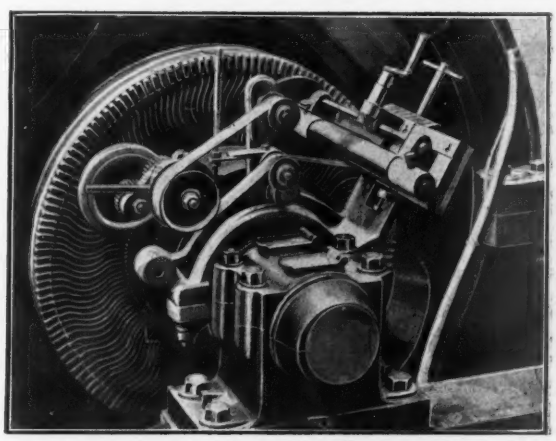
Oil circuit-breakers for A.C. work, and both D.C. and A.C. motor starters, as well as completely enclosed switchgear, rheostats and switchboards are exhibited, the last including part of a number of boards made by the firm for the Rawtenstall Corporation, to control rotary converters. Attention should also be drawn to various arrangements of interlocked switchgear made for the Admiralty.

Car Hood Circuit-Breaker.

These include a D.P. circuit-breaker interlocked with an equalising switch; D.P. circuit-breakers of the sociable type, an overload on either pole opening both breakers; and D.P. overload and reverse-current breakers coupled tandem, with overload release on both poles, and reverse-current release on one pole.

Phillips's Commutator Grinder Co., Ltd. (17).

The exhibit on this stand is almost sufficiently described by the heading of this paragraph; the company's ordinary machine has been fully dealt with in our pages. There is, however, a new development in this connection, in the shape of a special type of grinder for use on board ship. In many cases dynamos on ships



Phillips's Marine Commutator Grinder.

are fixed so close to the bulkheads that it is impossible to attach the ordinary Phillips machine, and the Admiralty has been in the habit of specifying for motor-driven grinders; but by suitable modifications in the design this difficulty has been overcome, the projection of the machine beyond the end bearing being done away with. The accompanying illustration shows the new marine type of grinder.

W. P. Theermann & Co. (136).

This firm makes a special business of electrical installation work for mills, factories, churches and private premises. To illustrate the plant and material put in by them in these directions, they exhibit a main switchboard for mill and power work, a motor-driven centrifugal pump, and starting panel for the same, distribution boards, and fittings, including electroliers. Small A.C. transformers for metal-filament lamp service are also exhibited.

British Thomson-Houston Co., Ltd. (48, 49, 50).

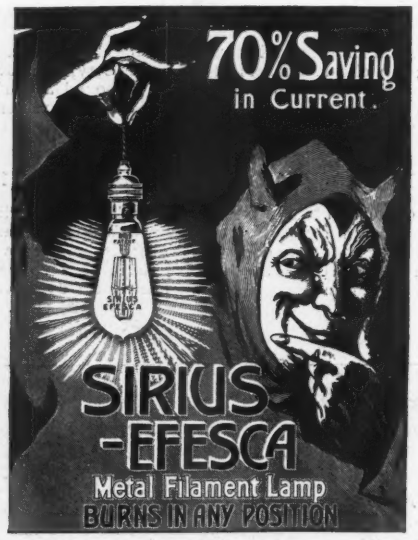
In addition to the horizontal Curtis steam turbine, to which we referred on page 697 of our last issue, this company have a selection of their standard electrical apparatus on view.

Of great local interest is a 52-spindle Brooks & Doxey ring spinning frame, operated by a 1-B.H.P. three-phase squirrel-cage B.T.-H. motor, running at 960 R.P.M., and equipped with a Whittaker Hall friction clutch and striking gear. Other motors on the stand include a 22-B.H.P. three-phase Form M induction motor, for a 400-volt circuit—this machine having a polar winding on the rotor, arranged similarly to the stator winding, and terminals carried through a hollow shaft to collector rings fitted with carbon brushes; also a 15-H.P. D.G. type motor of new design, suitable for installing on the floor, wall or ceiling.

A 500-watt auto-transformer for metallic-filament lamp circuits, and a variety of standard B.T.-H. instruments, together with leading examples of the company's controllers for both A.C. and and D.C. service, also arc lamps of the enclosed, flame and twin carbon types, and a number of electric heating and cooking devices, are on view.

Falk, Stadelmann & Co., Ltd. (145).

This exhibit is arranged primarily with the object of introducing or popularising the "Sirius-Efesca" tungsten metal-filament lamp in the Manchester district. In order to emphasise the qualities that are claimed for the lamp, a demonstration is given showing that it will burn in any position. This takes the form of a sort of star or rising sun arrangement, in which lamps radiate from a common centre, burning in all positions from the horizontal to the vertical. A series of suitable fittings, selected from the large variety that the firm have on sale, shows the application of the lamps to home, shop and industrial lighting. Before one comes to close quarters



A STRIKING DEVICE.

with the exhibit one's eye is caught by the now familiar individual who forms the feature of the "Sirius-Efesca" coloured show-sheets, of which a print is given above. This is a face which once seen is never to be forgotten, and a number of life-sized representations of this interesting individual are placed at different points of the stand, each holding up one of the lamps. There are four stationed at the entrance to the stand, and some six or eight others at the back or in the immediate vicinity of the star arrangement to which we have alluded above. The reader can imagine that when the lamps are all on, the scheme of arrangement produces a brilliant and effective display.

Fredk. Smith & Co., Ltd. (146).

This firm, so well-known in electrical and other circles for its manufactures in copper, &c., has a representative exhibit of wires, cables, &c., for all departments of electrical industry, including hard-drawn high-conductivity copper line wire made to Post Office specification, bare copper cable for power transmission, round and grooved copper trolley wire, sections of heavy high-conductivity copper strip, and straight lengths of heavy round copper. Silicium bronze wire for telephone purposes, phosphor-bronze springs, spring wire and tape, also aluminium bars, rods, wire and cable are present here.

Kirkpatrick & Rastall (184).

This firm's exhibit consists mainly of castings in various metals for the motor and electrical trades.

Copper, bronze and aluminium castings of all kinds are shown, including examples of cast commutator segments. The firm also specialises in steam fittings, engine and boiler mountings, &c.

Morris-Hawkins, Ltd. (107, 108).

Messrs. Morris-Hawkins are showing one of their country-house lighting sets, consisting of a 4-KW. 200-volt dynamo, driven by a Parsons paraffin engine, and used for lighting the stand. The cooling water is run to waste, and it is pointed out that this can often be done at trifling cost in the country. A new Lamplough patent pulsating pump driven by a 5-H.P. motor at 600 R.P.M. is another exhibit, shown in operation, and a variety of machines, including a motor-generator, a motor driving an air-compressor, and a small ship-lighting set, are shown.

At the same stand, Messrs. John Roberts & Co. (agents for the firm) are showing the Dewhurst patent automatic signals for tramways, which are artificially operated at a rate representing many times the normal frequency of the car service in Manchester, where four complete installations are at work. This system appears to have given great satisfaction on the various tramway systems that already employ it.

Cutler, Wardle & Co., Ltd. (265).

Messrs. Cutler, Wardle & Co. are showing a variety of material, principally metal spinnings, &c., in which they specialise. A novelty shown is a porcelain ceiling rose with a metal covering rolled on, this being in appearance much superior to the ordinary glazed porcelain rose.

The "Streetlite" fitting is also on view; the sole rights of this, we may mention, have been taken over by Messrs. Siemens. Palatine ignition batteries, electric fans, and coloured electric lamps, also figure on the stand.

A. G. Taylor & Co. (276).

Messrs. Taylor show a variety of small accessories, and make a special feature of their "quick grip" spanners and nut-gripping pliers, which take a considerable range of square or horizontal nuts, and will also deal with round work—the application being similar to that of ordinary pliers, and thus saving adjustments. A miniature high-voltage battery for medical purposes, embodying a hundred 1-volt cells, is also shown.

Cunliffe & Croom, Ltd. (296).

This firm have a representative display of machine tools, including an 8½-in. centre brass-finishing lathe; a 51-in. motor-driven vertical boring and turning mill, fitted with a speed gear giving eight table speeds, the motor being of 7 H.P., of the Lancashire Dynamo Co.'s make; a 30-in. boring mill of similar type; a motor-driven planer; and a number of drilling, milling and grinding machines. The drilling machines are of the pillar type, provided with self-acting feed and automatic trip motion, or hand-feed through gearing, or as a sensitive feed. The spindles are balanced, and the tables arranged to swing round the pillar.

J. P. Hall & Co., Ltd. (173, 233).

In this stand interest centres in a ring-spinning frame, of Platt Bros.' make, which is driven in the middle by a Hall 15-B.H.P. three-phase induction motor. The driving gear includes two Hele-Shaw friction clutches for starting the machine gradually. Other machines of Messrs. Hall's make include a 150-B.H.P. shunt-wound motor, a 300-KW. armature for a D.C. generator, and several other direct and alternating-current machines in sizes from 20 to 50 B.H.P.

Crossley Bros., Ltd. (269).

Messrs. Crossley's exhibit includes an anthracite suction-gas producer, which supplies one of the firm's latest type four-cylinder vertical gas engines, running at 220 R.P.M., and driving a 75-KW. generator. This plant is similar to that described and illustrated by us on page 244 in our issue of August last.

A standard low-speed horizontal engine of 55 I.H.P., and a small high-speed vertical electric lighting set are also shown.

As regards the latter, the engine gives some 12 H.P. at a speed of 700 R.P.M., and the generator has an output of 37 amperes at 220 volts pressure.

C. W. Burton, Griffiths & Co. (27).

The company's exhibits are principally milling machines of various patterns, and include a Milwaukee universal machine of latest type. A new "Garvin" lathe and a "Rice" sensitive drilling machine, also sets of master and limit gauges are shown.

Geo. Brady & Co. (181).

This firm are showing an electric push-button type service lift, and similar lifts for hand working. The feature of these machines is the patent self-sustaining mechanism with which they are fitted in place of the usual brake.

Several sets of gearing are shown, as well as a roller shutter in which the company also specialises.

Concordia Electric Wire Co., Ltd. (209).

The company's wire and cable exhibit is a representative one, including telephone and bell cord, lighting and traction cables, armoured flexibles, asbestos lapped and braided wires, &c.

An interesting feature is the 49 S.W.G. (·0012 in.) silk-covered wire—this being, we should imagine, almost a limiting size, which can be best examined with the aid of a microscope.

C. Redman & Sons (170, 171).

Messrs. Redman's exhibit is confined to two recent tools, a rapid planing machine, gear-driven by a 6 H.P. motor, and a 10-in. 12-ft. gap bed lathe of heavy proportions. The latter is a high-speed machine, driven by a 30-H.P. Royce motor, and is shown in operation.

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TELEGRAPH and TELEPHONE NOTES.

(*Continued from page* 746.)

Injuries to Cables.—The inter-departmental committee appointed by the Postmaster-General to inquire whether injury is caused to submarine cables by the operations of trawlers, and, if so, to recommend what steps should be taken to prevent such injury, has issued its report.

The Committee is of opinion that injury is sometimes caused to submarine cables by otter boards of certain types and boards out of repair, and by beam trawls with defective trawl-heads; there would be little risk of injury from trawls of either kind if they were always suitably constructed and in good condition. The owners of trawling vessels are generally willing to modify their trawling gear with the view of minimising the risk. The Committee is not prepared to recommend the proscription of any area beyond territorial limits. All cable companies should establish friendly relations with fishermen who frequent the waters in which their cables are laid; while the fishermen, on their part, should try to clear their trawls when they foul a cable, and should report the position of any contact with a cable.

A system of Government inspection of the gear of trawlers should, in the opinion of the Committee, be at once instituted, and steps should be taken to invite neighbouring foreign States to adopt a similar system of inspection. Eventually an international conference may be necessary to settle the terms of a convention on the subject.

The Committee finally recommends that the cable companies should consider the question of substituting heavier types of cable in the areas affected.—*Standard.*

St. Lucia.—The Annual Colonial Report for 1907 states that the telephone system consists of 111½ miles of trunk, and 48⅝ miles of branch line, or a total of 161⅛ miles. On December 31st, 1907, there were 116 subscribers, an increase of six over the previous year. Receipts amounted to £637, and expenditure to £771, exclusive of charges for interest and sinking fund.

St. Vincent.—The Annual Colonial Report for 1907-8 states that the revenue of the telephone department was £454, including £175 transferred to that head on account of Government installations. The expenditure was £337. The lines run from Kniptown to Chateaubelair on the leeward side of the island, and to Mesopotamia and Georgetown on the windward side, about 24 miles either way. The current year's estimates make provision for a cable news subsidy.

Wireless Telegraphy.—The Southern Wireless Telegraph Co. has been formed with a capital of $1,000,000 to erect a wireless installation on the Southern Trust Building, Little Rock, Arkansas, and also at eighteen other stations in Arkansas, Louisiana, Mississippi and Oklahama.

Mr. Valdemar Poulsen is erecting a wireless station in Ireland which is to communicate with Canada.

The Government of the Dominion of Canada is about to establish four more wireless stations in British Columbia owing to the success of those already established at Cape Lazo, Point Grey, Pachena, Estevan and Victoria. One of the new stations will be at Prince Rupert, the terminus of the Grand Trunk Pacific Railway on the Pacific Coast; one on the northern end of Vancouver Island and one on the Maresby Island of the Queen Charlotte Islands. The Canadian Pacific Railway Co. is also considering a proposition of the United Wireless Co. to equip all its vessels. The Inland Navigation Co. has already given orders for its ships to be equipped.

The new radio-telegraphic station at Varna will have a range of 385 miles, and the Bulgarian Government is negotiating with the Marconi Co. for the operating of the station.

The United States Naval Department, according to the *Telegraph Age*, is considering plans for the erection of a wireless installation on the top of Washington Monument, with the object of establishing communication with warships within a distance of 3,000 miles.

The first wireless telegraph station in Belgium has been set up at Nieuport.

CONTRACTS OPEN and CLOSED.

OPEN.

Argentina.—The Government is to expend 50,000 pesos (about £4,375) on the construction of telegraph lines in the province of San Juan to unite the capital of the province and Calingasta *vid* Desamparados, Marquesado and Barral, and the department of Jachil and La Iglesia *vid* Rodeo.—*Board of Trade Journal.*

Australia.—ADELAIDE.—November 20th. The City Council requires tenders for the supply and erection, complete, of a refuse destructor, electric lighting plant for the same, &c. Particulars may be obtained from the Agent-General for South Australia, 1, Crosby Square, Bishopsgate Street Within, E.C.

TASMANIA.—March 15th, 1909. Postmaster-General. Telephone switchboard, common-battery system and apparatus for use at subscribers' premises, Launceston. Specifications and particulars of general conditions can be inspected at the offices of the ELECTRICAL REVIEW.

VICTORIA.—Three sets of testing instruments, for the P.M.G. See "Official Notices" October 16th.

Belgium.—November 11th. Tenders are required by the Direction of the Belgian State Railways for an electric signalling cabin complete at the Nord Station. Particulars No. 260, 1908, are obtainable from Mr. de Rudder, 11, Rue de Louvain, Brussels.

Colchester.—November 30th. Electric lighting plant, motors, wiring, telephones, &c., for the Essex County Lunatic Asylum. See "Official Notices" to-day.

Dublin.—November 30th. Stores for the Dublin United Tramways Co. (1896), Ltd. See "Official Notices" to-day.

Eccles.—November 14th. Electric light wiring and fitting of the Cleansing and Scavenging Committee's buildings at the Town's Yard. Specification prepared by the borough electrical engineer is obtainable from the Town Clerk, Town Hall.

Germany.—The municipal authorities of Posen are about to invite tenders for the extension of the central electric lighting station at an estimated cost of £26,350.

Glasgow.—Electric lighting of Cameron Memorial Clock, Charing Cross. The Manager of Corporation Halls, City Hall, Glasgow.

G.W. Railway.—November 10th. Stores for the G.W. Railway. See "Official Notices" October 2nd.

Lancaster.—Check rails for repairs to electric tramway track.

Leigh.—November 7th. Steam slack for the B.C electricity department. See "Official Notices" October 23rd.

Leith.—November 10th. Materials for tramway extension for the Corporation. See "Official Notices" to-day.

November 10th. Underground cables for Corporation extension. See "Official Notices" to-day.

London.—November 2nd. Stores, fittings, carbons, &c., for the L.C.C. See "Official Notices" October 23rd.

November 10th.—Overhead equipment for the electrification on the overhead trolley system, of the L.C.C. tramways from Loughborough Junction to Norwood, from Hammersmith to Putney, and from Streatham to Norbury. See "Official Notices" to-day.

Roumania.—CRAIOVA.—December 20th. Tenders for the building and working of an electric tramway system. Deposit 50,000 fr. Particulars of the Conseil Municipal.

Salford.—November 2nd. Cooling towers, tanks, &c., for the Corporation. See "Official Notices" October 16th.

Spain.—HUELVA.—November 17th. Tenders are invited for the supply of four electric cranes and a travelling crane for this port. A deposit of 5 per cent. is required. Further particulars of the Junta de los Trabajos del Porto.

November 20th.—The municipal authorities of Almazan (province of Soria) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Almazan (Soria).

Thryberg.—November 9th. The lighting of certain streets, roads and places in the parish by electricity. Mr. O. Everitt, Clerk to the Parish Council, 4, Clifton Bank, Rotherham.

CLOSED.

Australia.—ADELAIDE.—For Postmaster-General:—

International Electric Co., London.—Induction coils, switches, switch boards, &c.

India-Rubber, Gutta-Percha and Telegraph Works Co.—Trembling bells galvanometers, lightning arresters, &c.

British Insulated and Helsby Cables, Ltd.—Conductor cords and plugs, telephone switchboards, lightning arrester boards, copper wire, tapes and binders.

Western Electric Co.—Telephone switches, switchboard and protectors.

Union Cable Co.—35 miles of No. 20 copper wire (india-rubber insulated), at £7 3s. 6d. per mile.

MELBOURNE.—For Postmaster-General:—

British Insulated and Helsby Cables, Ltd.—One mile 64-wire switchboard cable, £108 10s. per mile; five miles 100-pair double silk and single cotton light lead taped and braided switchboard cable, £855 per mile.

International Electric Co.—2,800 jacks, conductor cords, &c.

Sydney.—For Postmaster-General:—

International Electric Co.—15,000 best white porcelain insulators, large, $6\frac{5}{8}$d. each.
British Insulated and Helsby Cables, Ltd.—60 tons hard-drawn copper wire, 300-lb. per mile, £78 18s. per ton.
Oswald Raes, 2, Hunter Street, Sydney.—One ton copper binding tape, 200 lb. per mile, £83.
Zwicker, Tod & Co.—100,000 best white insulators, Australian pattern No. 6, $2\frac{3}{32}$d. each; 100,000 iron pins for same, $4\frac{7}{16}$d. each.
Johnson, Clapham & Morris, Ltd.—100 tons galvanised wire, 150 lb. per mile, £13 10s. per ton.

Birmingham.—The Birmingham, Tame and Rea District Drainage Board has accepted the tender of Messrs. Crompton and Co., Ltd., London, for additional electrical plant for the pumping station, at £796.

Brazil.—The *Diario Official* of September 27th contains a copy of a decree authorising Messrs. Felten & Guilleaume Lahmeyerwerke Akt.-Ges., of Mulheim a/R., to lay and exploit a submarine telegraph cable between the Brazilian coast and the Island of Tenerife.—*Board of Trade Journal.*

Carlin How.—The Skinningrove Iron Co., Ltd., have placed a repeat order with Messrs. Ehrhardt & Sehmer (sole British agents—The Key Engineering Co., Ltd.) for another 700-H.P. single-tandem gas engine, to be direct-coupled to a 500-volt three-phase A.E.G. alternator.

Falkirk.—An electric hoist is to be erected at the gas works, the offer of Messrs. Chambers, Scott & Co., Ltd., Motherwell, having been accepted for its erection. The gas manager has prepared a report as to generating electricity at the gas works for use at the works.

Glasgow.—The Tramways Committee has accepted the offer of Messrs. W. C. Yuille & Co. for the supply of mica insulated blocks.

Leigh.—The tender of Messrs. Morrison & Roebuck has been accepted for the electric lighting and ventilating installation at Bedford Leigh Theatre.

London.—Messrs. H. Hooper & Co., Ltd., of Lewisham, have obtained from Messrs. McCurdy, Ltd., Euston Road, the contract for installing electric lighting at their new stores at South Crescent, Store Street, Tottenham Court Road, W.C.

L.C.C.—The Highways Committee of the L.C.C. proposes to extend existing contracts with the Edison & Swan Co. for the supply of wiring material, and with Spagnoletti, Ltd., for switchgear, to the estimated amounts of £500 and £800 respectively, in connection with the connecting-up to the switchgear of the turbo-generators to be installed in the second portion of the Greenwich station. The following tenders have also been considered:—

Six Fuel Economisers.

J. Carter & Sons (not to specification)	£3,360
E. Danke & Co. (Oldbury), Ltd. (recommended)	3,878
E. Green & Sons	3,874
Goodbrand & Co.	3,935
Roberts Bros.	3,957
A. Lowcock, Ltd.	3,960
Clay Cross Co.	3,990

Three Electrically-Driven Three-Throw Feed Pumps.

	Pumps and accessories.	Spare parts.	Total.
Thwaites Bros.	£1,701	£150	£1,851
Pratchett Bros. (not to specification)	1,715	148	1,863
John Cochrane (recommended)*	1,717	175	1,892
F. Pearn & Co.	1,813	168	1,981
A. & P. Stevens	1,976	188	2,164
Electric Construction Co.	2,010	210	2,220
R. Warner & Co.	2,085	143	2,228
Worthington Pump Co.	2,389	171	2,561

* At £1,717 without spare parts.

Purchase of Plant at Victoria Embankment Station.

I. Levy & Sons (recommended)	£450
J. T. Williams	449
G. Cohen, Sons & Co.	250
A. Verey & Co.	306
White Bros.	240
Donald McCall & Co.	205
W. W. Martin	26

The Highways Committee proposes to make arrangements with Hadfield's Steel Foundry Co. for the supply of special steel trackwork, provided that the company is prepared to deliver at such reductions as the Committee may consider reasonable. It is estimated that the cost will amount to £22,000.

Rotherham.—The T.C. has accepted the tender of the Sheepbridge Coal and Iron Co., Ltd., for 5,000 tons of coal for the electricity works at 5s. 4½d. per ton, and the tender of Earl Fitzwilliam for 2,000 tons at 6s. 6d. per ton. The tender of Kelvin and James White, at £181, for switchboard extension, has also been accepted.

Salford.—The T.C. has accepted the tender of Messrs. G. Harland Bowden & Co., Glasgow, at £437, for the electric light installation at the Halton Bank School.

Sheffield.—After 12 months' trial, the Tramways Committee has placed an order with the Warner Engineering Co., Ltd., Westminster, to equip 12 cars with the Warner non-parallel axle system to follow the "conformity line."

Taunton.—The T.C. has accepted the tender of Messrs. Easton & Bessemer, of Taunton, for a compound double-acting engine for the Electricity Works, at £345.

Twickenham.—For installing the electric light at the new hospital, with steam engine and dynamo at the sewage disposal works, the U.D.C. received the following tenders:—

Nursey & Marr (accepted)	£1,158	General Electric Co., Ltd.	£1,299
G. Haden & Sons	1,549	Johnson & Phillips, Ltd.	1,284
Smeeton & Page	1,462	J. Dyer	1,273
Lund Bros. & Co.	1,422	W. Gifkins & Co.	1,266
I. B. Saunders & Co.	1,392	T. Hiscock	1,253
Tylex & Freeman	1,356	Tredegar & Co.	1,245
Pinching & Walton	1,348	H. Hooper & Co., Ltd.	1,244
Electrical Co., Ltd.	1,345	Brush Elecl. Eng. Co. Ltd.	1,244
D. J. Macdonald	1,344	Edmundson's Elec. Cor., Ltd.	1,190
Morris-Hawkins, Ltd.	1,344	Dargue, Griffiths & Co., Ltd.	1,151
W. J. Fryer & Co.	1,325	C. Pullan	1,109

Watford.—The U.D.C. has accepted the quotation of the National Boiler and General Insurance Co. for the insurance of new superheaters, increasing the total insurance of the boilers and superheaters from £3,600 to £5,000, at a premium of £6 17s. 6d. The tender of the Worthington Pump Co., at £141 10s., has been accepted for an oil separator. For extensions for this winter's load the Council has accepted the tender of Jas. Oakes & Co., at £5 1s. per ton, for the supply of 290 yards of 9-in. cast-iron pipes, and that of Mr. Ensor, at £18 5s., for laying the pipes.

West Ham.—The E.L. and T. Committee has accepted the tender of Gunn & Co. to supply 10,000 tons of North Country small coal, at 9s. 8d. f.a.s., to be delivered between April, 1909, and December, 1909, inclusive (a considerable reduction on the present price per ton); and 10,000 tons of washed peas, at 9s. 6d. per ton, to be delivered between January and December, 1909. Further, in consideration of these purchases, the firm agree to supply, for the remainder of the present contract, rough small coal only, instead of rough small and duff, at the present contract price, 9s. 6d., as compared with 10s., the price of a contract the Council has running with another firm.

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERDEEN.—New booking office, &c., for Aberdeen Joint Station Committee. J. A. Parker, 80, Guild Street, Aberdeen.

ABERYSTWYTH.—Nineteen workmen's houses for the Town Council (£3,000).

ADLINGTON (Lancs.).—New Council school (£4,500). H. Littler, county architect, Preston.

ALTRINCHAM.—Isolation Hospital for the U.D.C. Wm. Owen, architect, Duchy Chambers, Clarence Street, Manchester.

ALDERSHOT.—Alterations and additions to the destructor works for the U.D.C. The Surveyor.

ASHTON-UNDER-LYNE.—Lavatory, Market Hall, for the T.C. Borough surveyor.

BACUP.—Alterations to club premises, Britannia. S. T. Williams, architect, St. Mary's Chambers, Bankside Lane, Bacup.

BARNET.—Additions to Girls' Grammar School. John Ladds, architect, 93, Pemberton Road, Harringay, N.

BARNSLEY.—Two houses in Dodworth Road. A. Whitaker, architect, Saville House, Worsbro' Bridge, Barnsley.

BARNSTAPLE.—New chapel at Bishops Tawton, for the United Methodists. Houses at Pilton; W. C. Oliver, architect, The Square, Barnstaple; Mr. Rice, builder. Houses at Pilton Marsh; W. C. Oliver, architect, Barnstaple; Mr. Wakely, builder, Gloster Road, Barnstaple.

BECKENHAM.—Houses, Allen Road, for E. F. Smith; Blandford Road, for Golder & Co.

BEDFORD.—Six houses in Trinity Road; R. Jeakings, Hurst Grove, Bedford. Two villas in Beverley Crescent; T. Dickens, Stanley Street, Bedford. Six houses in Trinity Road; C. Melcombe & Son, Castle Road, Bedford. Villa in St. Augustine's Road; E. Whitmore, Bedford. Houses, York Street, for Mason and Corbett; Denmark Street, for Jacobs & Burton; alterations to premises, 12, Harpur Street, for W. A. Walker; alterations to premises, 10, Bromham Road, for S. Freshwater & Son, builders, 25, Castle Lane.

BELFAST.—Buildings on the Purdysburn Estate, for the Belfast Corporation Asylum Committee. Graeme-Watt & Tulloch, architects, 77A, Victoria Street, Belfast.

BELTURBET.—New schools for the Sisters of Mercy. Wm. H. Byrne & Son, architects, 20, Suffolk Street, Dublin.

BERKHAMSTED.—Houses, George Street, for Tutt & Son; Wigginton, for Brown & Co.; motor-car shop, Ravens Lane, for Sir R. P. Cooper.

BIRKENHEAD (Hoylake).—New public baths under consideration. Hoylake and West Kirby U.D.C.

BLACKPOOL.—New streets off St. Walburgas Road, for Thos. Marsden; 59 houses, New Road, for the Blackpool Laundry Co.; houses, Claremont Avenue, for J. Fish; St. Walburgas Road, for W. Howarth; St. Walburgas Road, for G. F. Clarke; Whitegate Drive, for H. H. Rose; Portland Park Estate, for T. Hunt; brick works, Warbrick Hill Road, for R. Fielding & Son; additions, Lytham Road, for the Social Club Committee.

BOLTON.—New schools at Tonge Moor, for the T.C. (£4,000). Works extensions in Chorley Street; Messrs. Brilsco, bleachers. Eight houses, Packer Street, for J. Brown.

BOURNEMOUTH.—New Girls' School at Boscombe (£3,300).

BRIDGEND.—New chapel in connection with Bryncethin Congregational Church.

BRIGHOUSE.—Electric transforming station, Sand Wharf, Huddersfield Road. S. S. Haywood, borough engineer, Municipal Offices, Brighouse.

BRIGHTLINGSEA.—House and shop, 50, Hurst Green, for E. Richardson; slaughterhouse, 23, Queen Street, for Capt. R. Salmon.

BRIGHTON.—Adaptation of premises adjoining Montague Place, for the Brighton, Hove and Preston United Omnibus Co., Ltd.; Clayton and Black, architects, 10, Prince Albert Street, Brighton. Alterations and additions to 12 and 13, Montpelier Crescent; J. Nutley, builder, 1 and 2, Dean Street, Brighton. Conversion of 32, Hartington Road into flats; W. A. Gates & Sons, builders, Brunswick Road, Shoreham, S.O., Sussex.

BROADWAY (Worcestershire).—New wing, &c., at St. Saviour's Monastery. R. Curran & Son, architects, Warrington.

CAERPHILLY (Glam.).—New higher elementary school (£10,500). T. Mansel Franklin, clerk to the Glamorgan C.C., Westgate Street, Cardiff.

CAMBERLEY.—Cottage hospital (£1,548). Wm. Watson, builder, Ascot.

CAMBRIDGE.—House, Adams Road, for F. S. Scales, St. Barnabas Road. Additions to Baptist Chapel, Mill Road; R. Vall, secretary, 33, Catherine Street. House, Grange Road, for Miss Clover, Girton College; shop, Mill Road, for J. V. Pryor, Petty Cury, Cambridge. Building in Downing Street for the Agricultural Department of the Cambridge University. W. Sindall, builder.

CARDIFF.—Eight houses, Ilton Road, for Geo. Beard; W. H. Scott, architect. Six houses, Clive Road, for T. Morris; Ivor Jones, architect, Cardiff. Six houses, Waterloo Road, for G. H. Leonard; W. H. Scott, architect. Four houses, Amesbury Road, for T. Galsworthy; W. H. Scott, architect. Warehouse for J. M. Watkins; Bruton & Foster, architects, Cardiff. Church Army Rescue Homes in Charles Street; C. Wells, architect, c/o Knox and Wells, Cardiff. Conversion of warehouses into offices in West Bute Street for M. Primavesi; W. Davies, architect, Cardiff. One house, Westville Road, for Geo. Haywood; W. H. Scott, architect, Cardiff. One house, Ilton Road, for W. Harding; W. H. Scott, architect. Gymnasium and reading room for St. Mary's parish (£1,000); G. E. Halliday, architect, Cardiff.

(Kenfig Hill).—New elementary school. T. Mansel Franklin, clerk to the Glamorgan C.C.

(Maindy).—New elementary school. T. Mansel Franklin, clerk to the Glamorgan C.C.

CASTLEFORD.—Public baths. H. H. Broadbent, clerk to the Castleford U.D.C.

CHELMSFORD.—Proposed new school at Springfield; Chelmsford Education Committee. Church Institute and Club rooms at Pleshey, for for C. W. Howis.

CHELSFIELD (near Orpington, Kent).—Bungalow residence for Jas. Crafter.

COLNE (Lancs.).—New Salvation Army Hall. Architect's Department, Salvation Army Headquarters, London.

COVENTRY.—Houses, Caludon Road, for A. Jeffs; Earlsdon Lane, for C. J. Smith; Northfield Road, for T. Reynolds; St. George's Road, for G. Nicholls; Holyhead Road, for Hancox & Co., builders, St. Patrick's Road; workshops, &c., Little Park Street, for T. D. Griffiths; houses and shops, Bramble Street and Fargosford Street, for W. Shortley.

CREWE.—Alterations to Mill Street Wesleyan Schools. H. D. Struthers, Director of Education, Crewe.

CROSS KEYS (Mon.).—Six houses at Cross Keys. Mr. Moore, architect, Cross Keys, Mon.

CROYDON.—Addition to laundry, 55, Summer Road; W. B. Coomber, 65, Pemdevon Road. Additions to Cottage Hospital, Brighton Road, Purley; J. Newton, Purley. Houses, Grange Road, Thornton Heath; Belfrage & Saville, architects, Chancery Lane, London, W.C. Lower Addiscombe Road, H. R. Hunter, Lower Addiscombe Road; Melfort Road, Thornton Heath, A. Gosheron, 280, Holmesdale Road, South Norwood, S.E.; houses and shops, Blackhorse Lane, Woodside, G. Miller, Coniston Road, Croydon.

CWMFELIN (Glam.).—New mixed and infant school (£5,090). T. Mansel Franklin, clerk to the Glamorgan C.C.

DARLINGTON.—Extensions to the works of the Blake Boiler Co.

(Scorton).—Home for Incurables building scheme (£16,000).

DARTMOUTH.—Alterations to Gunfield, residence of Lort Phillips. R. C. Pillar, builder, Castle House, South Town, Dartmouth.

DARWEN.—Extensions at Hope Cotton Mills. W. T. Ashton & Sons, owners.

DAVYHULME (near Manchester).—Houses, Trafford Road, for Taylor Bros. and Co., Trafford Park Works.

DELABOLE (Cornwall).—Villa residence. Apply at 21, Sea View Terrace, Plymouth.

DONCASTER.—New Roman Catholic day schools for Father Leonard (£3,000). Building developments adjoining Don Street, by C. Sprakes and Sons, builders, 87, East Laith Gate, and Wilburn & Sprakes, builders. Stables for the T.C.; C. Sprakes & Sons, builders.

DOUGLAS.—Building for the safe custody of documents in connection with the Rolls Office and Registry Office of Deeds, and alterations to present buildings. J. Cowle & Son, architects, St. George's Street, Douglas.

DOWLAIS.—Sixty-eight houses at Penywern for Merthyr Corporation. T. Aneuryn Rees, town clerk.

DRIFFIELD.—Proposed Congregational Sunday School.

DROITWICH.—House in Westwood Street; Miss Potter.

DUNFERMLINE.—Alterations to 80 and 10, Golfdrum Street, for David Downie, cycle manufacturer.

DURHAM.—Science and art block, &c., at Johnson Technical School, for Durham C.C. Oliver, Leeson & Wood, architects, Newcastle-on-Tyne.

EASTBOURNE.—Three pairs of semi-detached houses, Hampden Park; E. Marchant, builder. Private motor garage at Pevensey Bay, for Dr. E. Frost; A. Chandler, architect. House, Willingdon Road, Willingdon; M. Hookham, builder; Mitchell & Ford, architects. House, Brassey Avenue, for Eastbourne Artisans' Dwellings Co., Ltd.; Miller & Selmes, builders; Mitchell and Ford, architects. House, stabling, &c., for Mrs. Westhead; Clayton & Black, architects, Brighton.

EAST GRINSTEAD.—Proposed new school at Ashurst Wood (£4,000).

EAST RIDING (Yorks.).—New school and teacher's house at Foggathorpe and additions to infant school, Withernsea; B. B. Stamford, building surveyor, County Hall, Beverley.

EDINBURGH.—New Dairy Church of Scotland in Orwell Terrace.

FARNHAM.—Engine shed, stores, &c., at Ash, for Farnham R.D.C.; A. J. Stedman, surveyor, South Street Chambers, Farnham.

FAVERSHAM.—Stabling and workshops, Kingsnorth Road, for G. Brenchley.

FLIXTON (Lancs.).—Two houses, Flixton Road, for Mr. Shawcross.

FOCHRIW (Glam.).—New infants' school (£3,120). T. Mansel Franklin, Clerk to the Glamorgan C.C.

GERRARDS CROSS.—House, Oak End Way, for G. E. Slater; house, Bulstrode Way, for the London and County Investment and Property Co.

GLASGOW.—Warehouse building at 332, South York Street; R. F. Baker, 435, Govan Street, Glasgow. Buildings in Carlton Place; W. Calder and Sons, Carlton Place, Glasgow.

GLOUCESTER.—Extension of the Shire Hall for education offices (two electric push-button lifts to be installed), Mr. Phillips, architect.

GOLCAR.—Two houses, Long Croft Road. Arthur Shaw, architect, Golcar.

GORSEINON (Glam.).—Place of worship for the trustees of Libanus Calvinistic Methodist Church. D. Morgan, Liverpool House, Kingsbridge, Gorseinon.

HADFIELD.—New workshops and houses. Local Co-operative Society.

HALIFAX.—Extensive alterations to shops at West Vale, for the Sowerby Bridge Industrial Society, Ltd. Medley Hall & Son, architects, 1, Harrison Road, Halifax.

HANLEY.—Five houses in Baskerville Road, A. Madeley; additions to works in Ivy House Road, for J. & G. Meaken; alterations to house, Keelings Road, George Ridgway & Son.

HARROGATE.—Motor and boiler house, Kent Road, and additions to house and new house, Duchy Road, for D. Simpson, builder; houses, Langcliffe Avenue, for J. H. Brown; Manor Road, for J. H. Binns; Burke Street, Bilton, for J. E. Smith; Rutland Road, for D. Simpson; bungalow, Bilton Lane and Bilton Grove Avenue, for C. A. Nettleton, builder, Balmoral House, Bilton.

HASTINGS.—Conversion of houses into flats, for E. N. Knocker. C. H. Cocks and Son, builders, Stonefield Road, Hastings.

HECKINGTON (Lincs.).—Alterations and additions to residence for Ernest H. Godson. Herbert Walker & Son, architects, Southgate, Sleaford.

HECKMONDWIKE.—Almshouses in connection with the parish church (£2,000); also new school (£1,000). Rev. R. A. Henderson, vicar.

HERNE BAY.—Bungalow, Oxenden Park Drive, for Owen Way. J. Huxtable, architect, Station Road, Herne Bay.

HEYWOOD.—Projected new Council Schools, Regent Street. Director of Education, Heywood.

HIGH WYCOMBE.—Business premises, Church Street, for H. J. Cox; houses, London Road, for A. E. Reed & Co., paper manufacturers; Amersham Hill, for H. T. Dickens; Roberts Road, for Mr. King; Rectory Avenue, for A. C. Boorman.

HITCHIN.—Reservoir and water tower, Windmill Hill, for the U.D.C. (£10,000).

HUDDERSFIELD.—Two houses at Quarmby. Lunn & Kaye, architects, Milnsbridge.

(Birkby).—New Elementary School and Public Swimming Bath. K. F. Campbell, borough engineer, Huddersfield.

HULL.—Art Gallery at the Public Hall, for the T.C. J. H. Hirst, city architect, Town Hall, Hull.

HYDE.—House, Bowlacre Lane, for T. C. Beeley; conversion of premises in Hyde Lane into two houses and shops, for Miss S. Harrison.

KELLS (Co. Meath).—Farm buildings at the Convent of Mercy. T. F. McNamara, architect, 50, Dawson Street, Dublin.

KILLAY (near Swansea).—New Council School. T. Mansel Franklin, clerk to County Council, Cardiff.

KING'S WALDEN (near Hitchin).—Probable re-erection, after fire, of Lane House, King's Walden Estate.

KIRKCALDY.—New Free Church at Pathhead (seat 400).

LEWES.—Villa, Cliffe Hill, for P. H. Vinall.

LINTHWAITE.—Two villas, Manchester Road. Lunn & Kaye, architects, Milnsbridge.

LINTON HEATH (near Burton-on-Trent).—New Primitive Methodist Church and schools. S. H. Langley, architect, Berridge Street, Leicester; Mr. Bradford, builder, Leicester.

LISCARD (near Birkenhead).—New Catholic schools (£4,000). P. Rothwell, builder, 174, Conway Street, Birkenhead.

LITTLEBOROUGH.—Extensions at Grove Dye Works.

LONDON.—(Southwark, S.E.).—Building in Providence Place, Dantzic Street. C. Yates & Co., builders, 106, Campbell Road, Bow, E.

(Child's Hill, N.W.).—Branch fire station. S. S. Crimby, surveyor to the Hendon U.D.C.

(Chelsea, S.W.).—Building in Draycott Avenue for the Committee of Homes for Working Girls. Seth-Smith & Munro, architects, 46, Lincoln's Inn Fields, W.C. Additions to premises for the Chelsea Art Club; L. R. Guthrie, secretary to the Club, 143-5, Church Street, Chelsea, S.W.

(Kensington, W.).—Studio at 13, Kensington Square. Prof. R. E. Smith, King's College, Strand, W.C.

(Harrow).—Fifty-two houses. C. H. E. Bridgen, builder, Harrow.

(Silvertown, E.).—Additions to Spencer, Chapman & Messel's factory. G. Munday & Sons, builders, Islay Wharf, Poplar.

(Plumstead, S.E.).—New Baptist Church at junction of Griffin and Brewery Roads (£10,000).

(Hendon, N.W.).—Eight houses, Templars Avenue; E. Streather, builder, Sanderstead Station, Croydon. Development of Beddington Estate; W. Hollis, surveyor, Church End, Finchley, N. Six houses, Hale Lane; G. H. Gilbert, 35, The Parade, Edgware Road, Cricklewood, N.W.

(Lee Green, S.E.).—Three houses. W. A. Jewell, 21, Gateley Road, Brixton.

(Hampstead, N.W.).—Homes for working ladies, Hampstead Garden Suburb, and 12 cottages, Erskine Hill; Improved Industrial Dwellings Co., Ltd., 33, Finsbury Square, E.C. Buildings in Hampstead Road; J. Willmott & Sons, builders, Tottenham Lane, Hornsey.

(Willesden, N.W.).—Rebuilding Dollis Hill House, Gladstone Park. Willesden District Council.

(Old Cavendish Street, W.).—Rebuilding No. 20 for J. Soper, window blind manufacturer. W. J. Maddison, builder, Clarkson Street, Canning Town, E.

(Cubitt Town, E.).—Manual training centre. T. J. Bailey, Education Architect, L.C.C., Springs Gardens, S.W.

(Walthamstow, E.).—Six houses. A. G. Barton, builder, Daventry Works, Walthamstow.

(Hanover Square, W.).—Rebuilding Harewood House (£38,000). G. D. Martin, 3, Pall Mall East, S.W., and D. Blow, 9, King's Bench Walk, E.C., joint architects.

(Canning Town, E.).—Residence for Women's Settlement (£3,600). H. C. Lander, architect, Effingham House, Arundel Street, W.C.; Mattock & Parsons, builders, 165, Gray's Inn Road, W.C. Additions to offices for Howard Bros. & Co.; F. Tribe and Co., builders, Alperton, Wembley.

(Finsbury Park, N.).—Music Hall. F. Matcham & Co., architects, 9, Warwick Court, W.C.

MAESTEG.—Two semi-detached villas in Neath Road; Frank B. Smith, architect, Port Talbot. New Roman Catholic Schools (£2,391).

MAIDSTONE.—Houses, Sheals Crescent, for W. T. Burrows, builder, 27, Hedley Street; Church Road, Tovil, for Geo. Ovenden; motor shed, Bower Mount Road, and premises for Adult School, Church Road, Tovil, for Clark & Epps, builders, Cornwallis Road; two lock-up shops, Bower Place, for Geo. Hollands.

MANCHESTER.—New secondary school for girls, Chorlton Street, Manchester. W. H. Talbot, Town Clerk, Town Hall, Manchester.

MANSFIELD.—Houses, Carter Lane, for M. Morris; Victoria Street and Moor Street, for Geo. Boot; Goldsmith Street, for A. J. Copestake; Victoria Street, for Miss Brailsford; Victoria Street, for S. Litchfield; George Street, for J. Parsons; Newgate Lane, for J. Henderson; King Edward Avenue, for J. Beckett; Baums Lane, for Thos. Smith; Moor Street, for H. Hole; Newgate Lane and Hardwick Street, for J. Templeman; additions to offices, Rock Valley Works, for Barringer, Wallis & Manners; new bank for the Nottingham and Notts Banking Co., Ltd.

MARLBOROUGH.—House for Dr. T. C. Lawson, Avebury.

MARPLE.—House and shop for S. T. Bowden, Church Lane.
MATLOCK.—New United Methodist Church and Schools (£2,750). Suggested Central Hospital; District Council.
MERTHYR TYDVIL.—Thirty-eight houses at Danyderi, Merthyr Vale, for Corporation. T. Aneuryn Rees, Town Clerk, Merthyr Tydvil.
MORRISTON.—Parish Hall (£3,000). Walters & Johns, builders, Dillwyn Street, Morriston.
MYTHOLMROYD.—Six houses, Cragg Road, for Mrs. M. Stansfield.
NANTWICH.—Proposed new Cottage Hospital, site given by W. H. Foster, Appley Park, Bridgnorth.
NELSON.—New dye works. V. Whitehead, architect, Nelson.
NELSON (Glam.).—New School (£5,300). T. Mansel Franklin, Clerk to the Glamorgan C.C.
NEWCASTLE-ON-TYNE.—Five houses in St. Margaret's Road, four in Emily Street, and two semi-detached villas at Nun's Moor Crescent.
NORTHFLEET.—Houses, Seymour Road, for G. Barney; Bridgland & Clay, architects; and All Saints' Road, for W. R. Barton, builder, 57, Parrock Street, Gravesend.
NORWICH.—Pavilion of isolated cubicles at the Isolation Hospital, for the T.C. A. E. Collins, city engineer, Guildhall, Norwich.
NOTTINGHAM.—New School on Haydn Road, for the Borough Education Committee (£21,200).
OGMORE VALE (Glam.).—Higher Elementary School (£8,625). T. Mansel Franklin, clerk to the Glamorgan C.C.
OSWESTRY.—Proposed Public High School for Girls, for Salop C.C. G. W. Ferrington, solicitor, 18, Arthur Street, Oswestry.
OXFORD.—Electrical laboratory at New College, for the University (£22,000), gift of the Drapers' Company. T. G. Jackson, architect. New St. Margaret's Vicarage.
PAULTON (near Bristol).—Church House and Institute (£1,500). T. Melhuish, jun., architect.
PENARTH.—Laboratories for Penarth County School. T. Mansel Franklin, Cardiff.
PENDLETON.—New shops at Irlams-o'-th'-Height; Eccles Co-operative Society. Further extensions of works, Lancaster & Tonge, engineers.
PENGAM (near Cardiff).—Probable re-erection (after fire) of shops, for E. Hughes, builder, Pengam.
PENWORTHAM.—Tramway shelter. Preston Corporation.
PERTH.—Warehouses, &c., on site of 66 and 67, Meal Vennel, for D. M'Diarmid, grocer, South Street. Proposed public hall at Balbeggie.
PONTARDAWE (Glam.).—New elementary school; T. Mansel Franklin, clerk to the Glamorgan C.C. Twenty-three houses at Gwauncaegurwen; R. L. Sails, builder, 2, Finsbury Terrace, Swansea.
PONTYPRIDD.—Girls' intermediate school. T. Mansel Franklin, clerk to the Glamorgan C.C.
PORTH.—Pupil Teachers' Centre. T. Mansel Franklin, clerk to the Glamorgan C.C.
PORTSMOUTH.—Rebuilding of the offices of the Hampshire and Landport Building Society, for Lloyd's Bank, Ltd.
PORT TALBOT.—New infant school (250 scholars); boys' school and house. T. Mansel Franklin, clerk to the Glamorgan C.C.
PRESTOLEE (Lancs.).—New Council school for the Radcliffe Educational Authority. H. Littler, county architect, Preston.
PRESTON.—Laundry rooms, &c., at Roebuck Street Council School (£600 or £700).
RICHMOND-ON-THAMES.—Works for the Main Sewerage Board (£2,205). S. W. Harrison & Co., contractors, Birmingham.
ROTHERHAM.—Proposed new infirmary for the Board of Guardians.
ROYSTON (Herts.).—School, manual instruction and cookery centre (£5,356). Surveyor, County Council, Hertford.
RUGBY.—Contemplated developments. Local Co-operative Society.
ST. ALBANS.—New Primitive Methodist Church in Boundary Road.
ST. HELENS.—Re-building nave and aisles of St. Thomas's Church. Frank S. Biram, architect, St. Helens.
SHEFFIELD.—Young people's institute in connection with Attercliffe Wesleyan Methodist Church. New infant school in connection with Owler Lane School.
SALTBURN.—New Primitive Methodist Church (£5,000). Baines & Son, architects, London.
SEAHAM HARBOUR.—New Council school at Dawdon Colliery (900 scholars). J. Eltringham, architect, 11, John Street, Sunderland.
SKEWEN (Glam.).—Alterations to Skewen Lower Schools. T. Mansel Franklin, clerk to the Glamorgan C.C.
SOUTHPORT.—Extensions to St. Cuthbert's Church, North Meols. I. Taylor, architect, Manchester.
SKIPTON.—New school at Alder Hill.
SMETHWICK.—Three shops at Uplands and six houses in Beechfield Road, for T. W. Evans; two houses in Sycamore Road, for D. T. Bache; two houses in Marshall Street, for W. Lees; three houses and stable in Bearwood Road, for C. H. Simcox; 14 houses in new road off Lewisham Road, for J. H. Lees; alterations and additions at Spon Villa, Oldbury Road, for S. Nightingale.
SOUTHEND-ON-SEA.—Houses, Highcliffe Drive, R. James; Lovelace Gardens, Welbourne Bros.; Hainault Avenue, F. Padley; Westborough Road, G. H. Griffiths; Beedell Avenue, W. G. Whitley; Park and Queen's Roads, J. Porter & Co.; Christchurch Road, C. Ladd; King's Road, J. C. Gaillard; Stornoway Road, J. R. Smith; Lord Roberts Avenue, W. J. Weston; Southchurch Beach Road, A. Garrard; Richmond Street, Chas. Wingrave; Glenwood Avenue, J. Dartnell; South View Drive, W. L. Knight; Drake Road, J. Atkinson; Westborough Road, C. J. How; St. George's Park Avenue, J. Kendall; Glenwood Avenue, F. Kearney; Boscombe Road, H. A. Harris; bungalows, Southview Drive, L. C. Hyatt; South Avenue, Goldsworthy Bros.; Recreation Avenue, A. W. Osborne; South Avenue, W. C. Mills; shops, workshop and dairy, Nelson and Leigh Roads, A. J. Arnold; motor house, Selina Lodge, Southchurch Beach Road, J. Boorer; warehouse, Southchurch Road, D. E. Kerridge; conversion of two houses and shops into one, Westborough Road, W. Squire; additions, Westcliffe Hotel, Westcliff Parade, W. J. Hockley; offices, Clarence Street, Talbot and White.
SPILSBY (Lincs.).—Two houses, Ashby Road. F. W. Rimington, builder, Spilsby.
STAFFORD.—New Council School at Tenterbanks (500 scholars). Staffs Education Committee.
STIRLING.—Proposed public baths. Town Council.
SWANSEA.—Rebuilding 2 and 3, High Street, for D. Jones & Co., Ltd. Chas. T. Ruthen, architect, Swansea.
TAUNTON.—Officers' dwellings, &c., at Cotford Asylum, Taunton (£926). R. Norton Fitzwarren, Taunton.
THORNBURY (Glos.).—Class and cloak rooms at the grammar school. F. J. Williams, architect, Chapel Street, Thornbury, R.S.O.
THRYBERGH (Yorks.).—Public installation of E.L. for the P.C. Oswin Everitt, clerk to the P.C., 4, Clifton Bank, Rotherham.
TIDESWELL (Derbyshire).—Improved sewage works. Tideswell Parish Council.
TRURO.—New Cathedral schools. F. L. Pearson, architect to the Dean and Chapter.
TUNSTALL.—Six houses in Heath Street, Chesterton. P. Jenkinson.
TURRIFF.—House at Mill of Turriff. G. Simpson, Mill of Turriff, Aberdeenshire.
TWERTON-ON-AVON.—Higher Elementary School (£6,000). Somerset County Education Committee.
WARRINGTON.—Extension of the Technical Institute, for the Education Committee (£3,000).
WATERFOOT (near Manchester).—New Vicarage at Newchurch, for the Rev. H. Johnson, M.A., vicar of St. Anne's, Edgeside (£2,000). A. Brocklehurst, architect, St. James' Chambers, Waterfoot.
WATFORD.—Additions to business premises, Harwoods, Ltd.; H. J. Impey, 167, Castle Street, Luton, surveyor. Additions, Paget Prize Plate Co.'s works, St. Alban's Road; alterations and additions for Watford Steam Laundry Co., at Chalk Hill and Sidney Road; alterations and additions, Nos. 9, 11 and 13, Water Lane, J. Rodwell, builder, Bushey Hall Road, New Bushey, Watford; houses, King Edward Road, for Mr. Wright; The Avenue, Nascot Estate, for H. Martin; Oxhey Road, for Mr. Cartwright; stable and motor house, Clarendon Road, for Dr. Smith.
WELLS.—Laundry and alterations to Wells Asylum (£5,520). H. W. Pollard, builder, Bridgwater.
WESTBURY (Wilts.).—Eight houses, Dilton Marsh, for the R.D.C. (£1,380). E. Linsey, builder, Dorset House, The Halve, Trowbridge.
WESTWOOD (Co. Durham).—Buildings at Westwood Station for the North-Eastern Railway Co. Wm. Bell, architect to the company, Central Station, Newcastle-on-Tyne.
WHETSTONE (near Leicester).—New Baptist Church (£1,700). Tait and Herbert, architects, Leicester.
WIMBORNE (Broadstone).—Enlargement of Broadstone Church (£750). W. J. Fletcher, architect, County Surveyor's Office, Wimborne.
WINCHCOMB.—Residence and stables. Thos. Malvern, architect, 21, Winchcomb Street, Cheltenham.
WINDSOR (Dorney).—Alterations to Dorney Vicarage for the Rev. A. Sharp.
WOKINGHAM.—Houses, Ellis Road, near Crowthorne, for Mrs. Chappel; The Avenue, near Crowthorne, for Mark, Martin & Sons; Ellis Road, near Crowthorne, for Allaway & Blatch; laundry in Arborfield Road, Shinfield, for E. R. Chapman.
WORKSOP.—Houses, Central Avenue, for C. Bacon; bungalow, Darfoulds, for J. E. Hodding; post office buildings, Newcastle Avenue.
WORTHING.—Three houses, Lanfranc Road, for C. Strafford; J. E. Lund, architect. Two houses, Grand Avenue, for Hayward & Co. Six houses and shops, Tarring Road, for W. Weller; Farmer and Co., architects. Two houses, Highfield Road, for J. A. East; H. Bartlett, architect. Six houses, Reigate Road; G. Whayman, architect.
WREXHAM.—Church house, Regent Street. Prothers, Phillpott & Barnard, architects, 13, Promenade, Cheltenham.
WYMONDHAM (Norfolk).—New Baptist Church building (£1,000). Rev. J. Turner, Pastor, Wymondham.
YEOVIL.—New premises for the Yeovil Adult School.

FORTHCOMING EVENTS.

To-day's Events (Friday, October 30th).—At 8 p.m. Institution of Mechanical Engineers. Continued discussion on Mr. J. E. Darbishire's paper on "Repairs, Renewals, Deterioration and Depreciation of Workshop Plant and Machinery."

Saturday, October 31st.—Manchester Electrical Exhibition closes.

Monday, November 2nd.—At 5 p.m. Royal Institution. General monthly meeting.

At 7.45 p.m. Holborn Restaurant. Smoking concert of the P. and O. Batti-Wallahs' Society.

Tuesday, November 3rd.—At 8 p.m. Institution of Civil Engineers. First ordinary meeting. Presidential address by Mr. J. C. Inglis, and presentation of medals, &c.

At 7.30 p.m. At the University, Manchester. Institution of Electrical Engineers, Manchester Section. Paper on "Practical Considerations in the Selection of Turbo-Alternators," by M. Kloss.

Thursday, November 5th.—At 8.15 p.m. At 20, Hanover Square. Röntgen Society. Presidential address on "The Amsterdam Congress," by Mr. W. D. Butcher.

At 8.30 p.m. Chemical Society. Ordinary meeting.

Friday, November 6th.—At 7.30 p.m. At the Lit. and Phil. Society, Newcastle-on-Tyne. North-East Coast Institution of Engineers and Shipbuilders. Annual meeting.

Tuesday, November 10th.—At 7.30 p.m. At the Municipal School of Technology, Manchester. Institution of Electrical Engineers, Manchester Students' Section. Paper on "Brushgear," by Mr. R. F. Blackmore.

Thursday, November 12th.—At 8 p.m. Institution of Electrical Engineers. London. Opening meeting. Presentation of awards. Inaugural address by Mr. W. M. Mordey.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued :—

Monday, Nov. 2nd.—"A" Company. Technical drill, 6.30 to 9.30 p.m.
Tuesday, Nov. 3rd.—"B" Company. Technical drill, 6.30 to 9.30 p.m.
Thursday, Nov. 5th.—"C" Company. Infantry drill (Recruits), 6.30 p.m.; technical drill, 7 to 9.30 p.m.
Friday, Nov. 6th.—"D" Company. Technical drill, 6.30 to 9.30 p.m.
Tuesday, Nov. 3rd, and every Tuesday until further orders.—Medical inspection for recruits, 6.30 to 7.30 p.m.

(Signed) J. H. S. Phillips,
Capt. and Acting Adjutant.

NOTES.

The Passing of the Manchester Exhibition.—On Saturday last the number of visitors to the Electrical Exhibition totalled practically the same as on October 17th. The gates were closed several times during the afternoon, but not in the evening, and everything is now working smoothly for the winding-up to-morrow after a month of unequalled success. *Finis Coronat Opus!* On the occasion of our last visit, we were shown practical demonstrations of the Climax hand fire extinguisher, with which the Exhibition is equipped, the company being officially appointed by the Executive Committee to protect the buildings. The Underwriters and Empire fire extinguisher was also operated in our presence. In the first case it is only necessary to drive in a knob, and the apparatus immediately throws a jet 35 to 45 ft.; to actuate the other, one simply turns it bottom up to play, and reverses it for stopping. The Empire throws out a stream to a distance of 45 to 50 ft., according to the quality of the chemicals used. We have pleasure in calling special attention to both these admirable appliances for the protection of factories, theatres, houses, hospitals, schools, hotels, and buildings of every kind.

New York Tunnel Lines.—The two tunnels under the North River, New York, for the Pennsylvania Railway have been bored, and the cast-iron tubes, 23 ft. in diameter, are in place. A departure from ordinary practice is being made in these underground lines, for the tubes are having a concrete lining 2 ft. thick put inside them, thus reducing the effective diameter to 19 ft. Our information does not state whether this lining formed part of the original scheme, or whether it is in the nature of an additional precaution against collapse or leakage adopted since the tunnels were put in hand. With a backing of cement grout and this internal lining, the tubes ought to be as indestructible as the Pyramids.

Football.—A football match was played between the L.C.C. Tramways Sub-Stations' team and the Hammersmith and City Railway Co.'s team, on the morning of Thursday, last week, at Clapham Common; the result was L.C.C. Sub-Stations 4; Hammersmith 2.

Institution and Lecture Notes.—American Society of Mechanical Engineers.—The annual New York meeting of the American Society of Mechanical Engineers will be held on December 1st to 4th inclusive. Through the courtesy of the Secretary of War, a comprehensive presentation of the subject of aeronautics will be made at this meeting. Major Geo. O. Squier, acting signal officer of the United States army, will read a paper upon the development of aeroplanes and dirigible balloons, and a less technical lecture will be given by Lieut. Frank P. Lahm, of the signal corps. Important problems connected with metal cutting will be discussed, including the development of the milling machine to meet modern conditions. The results will be given of tests upon milling cutters, which afford data for the design of milling machines. The stub form of gear tooth will also be discussed, comparing the characteristics of a short tooth having a large angle of obliquity with the standard gear tooth now generally used in America, and covering the use of stub gearing of this type in automobile and electric railway work and in rolling-mill practice. Other papers will treat of the properties of saturated and superheated steam, tests of large power units, &c.

Junior Institution of Engineers.—The annual general meeting of this Institution was held at the Royal United Service Institution, Whitehall, on October 19th, the chairman, Mr. Frank R. Durham, A.M.Inst.C.E., presiding. Salient features of the Council's report relating to the year 1907-8, which was presented and adopted, included reference to the increase in the membership roll, bringing the total to 1,042, the election of Mr. James Swinburne, F.R.S., as president, in succession to the late M. Gustave Canet, and as vice-presidents, Sir William Huggins, K.C.B., O.M.; Sir Archibald Geikie, K.C.B.; Sir Robert A. Hadfield; and Prof. J. J. Thomson, F.R.S. Nine meetings for the reading and discussion of papers, and 38 visits to engineering works, &c., had taken place, with an average attendance respectively of 116 and 74. A Bronze Medal (the Junior Members' award) has been awarded to Mr. Gilbert Whalley, for his paper on "Notes on the Testing of Gas Engines." The successful summer meeting in France, during which the well-known works of Messrs. Schneider & Co. were visited; the twenty-fourth anniversary dinner; the conversazione; the establishment of the building fund; the first local section of the Institution (at Birmingham); the benevolent fund; the library; and the monthly journal and record of transactions, forming for the year a volume of 680 pages, were other matters dealt with in the report, and special reference was made to the foundation of the Durham Bursary, due to the kindness of Mrs. F. R. Durham. The award for the year 1908-9 had gone to Mr. L. M. Jockel, of Edinburgh, his thesis being on the subject of "Electricity in Mining." The finances of the Institution were reported as being in a healthy state. The election of officers and members of Council resulted as follows:—Chairman, Mr. F. R. Durham; vice-chairman, Mr. G. T. Bullock and Mr. J. Wylie Nisbet; hon. librarian, Mr. C. H. Smith; hon. auditors, Mr. H. Norman Gray and Mr. Henry Cook; ordinary members of Council, Messrs. S. N. Bylander, L. M. G. Ferreira, B. E. Dunbar Kilburn, and John Weston; district members of Council, Messrs. C. T. Briggs, Ernest King, Geo. H. Hughes, Eustace W. Porter, A. Don Swan, W. E. Lilly, and H. F. Hunt.

Liverpool and District Electrical Association.—On Saturday, October 24th, a party of members of this Association paid a visit to the Manchester Electrical Exhibition. On arriving at the Exhibition the party split into several smaller parties, and a complete inspection was made of various stalls; the members were highly pleased with the numerous exhibits, and spent a very interesting time, due in no small measure to the courtesy of the attendants at the stands. The outing was in charge of Messrs. W. H. Fennell and J. Greenhalgh (Members of Council), and Mr. Samuel Frith, Hon. Secretary and Treasurer, Bootle.

The Institution of Electrical Engineers.—The opening meeting is fixed for Thursday, November 12th, at 8 p.m., when the Premiums awarded for papers read or published during the Session 1907-8 will be presented, and the president, Mr. W. M. Mordey, will deliver his Inaugural Address.

Welding.—The *Railway and Engineering Review* (Chicago) is responsible for the statement that the Fusion Welded Metals Co., of London, control a process by which high-speed tool steels can be welded to other steels, so cheapening high-speed tools for heavy work. The welding is performed by means of a thin film of copper, which is placed along the line of the joint. The parts to be welded are then surrounded by a reducing compound and subjected to a temperature of about 2,200° F. The gas which is formed by the burning of the compound reduces the copper to such a very thin fluid state that it is said to penetrate the surfaces of steel and to produce not only adhesion (as in soldering), but also cohesion, and the joint has all the characteristics of a weld.

Insulators for the Midland Railway.—In one of our Exhibition articles last week we referred to the high-pressure insulators used for the Midland Railway Co.'s single-phase section at Heysham; these were all made by Messrs. Taylor, Tunnicliff and Co., but we inadvertently associated them with the products of another firm. Our apologies are due to Messrs. Taylor, Tunnicliff, especially as this is the second occasion on which they have suffered the loss of the credit which is their due—though on the former occasion we were not responsible for the mishap.

Restoration of Patents.—According to a number of notices appearing in the *London Gazette* on October 23rd, Mr. Harold F. Kemp, receiver for the debenture-holders of the Mica Boiler Covering Co., Ltd., in liquidation, has applied for the restoration of the following patents which expired in 1907, owing to non-payment of renewal fees:—H. C. Michell, No. 25,788 of 1904, No. 16,058 of 1895, No. 6,616 of 1898, No. 4,969 of 1901, No. 4,970 of 1901, and No. 25,787 of 1904, all relating to non-conducting coverings, &c., for boilers, pipes, &c.

Appointments Vacant.—Charge engineer for the Bristol Corporation Electricity Department (50s.); installation assistant for Belfast (30s.); shift engineer for Middlesbrough (35s.); junior assistant engineer for Leek (£65).

New Factory.—According to the *Folkestone Express* the Stolz Electrophone Co., of Chicago, with London offices at 82, Fleet Street, manufacturers of a patent pocket telephone for the deaf, have decided to move the foreign department of their works to London, in order to meet the requirements of the new patent law. The company will employ about 600 hands.

The Ideal Home Exhibition.—At this Exhibition, recently held at Olympia, Messrs. Rashleigh Phipps & Co. had on show a complete and inexpensive plant for 70 10-c.p. Osram lamps. A complete electrically fitted kitchen and a number of heating and domestic appliances were also shown.

Travellers' Ways.—In the City of London Court, on Tuesday, before Judge Lumley-Smith, K.C., the London Electrical Co., 28, Martin's Lane, Cannon Street, sued Mr. Henri, High Street, Manor Park, for the amount of an account for lamps and shades supplied in the way of trade. Defendant said that he never gave any order for the goods. Plaintiffs' traveller worried him to give an order, and he refused. Some time afterwards the traveller came with the goods. He (defendant) declined to accept them; but the traveller asked to be allowed to leave them for a little while. He never returned. Plaintiffs said their traveller was quite sure a definite order was given, or the goods would never have been left. Three weeks ago the defendant returned the goods, and they were taken in. Judge Lumley-Smith commented upon travellers' practices, and said he must find for the defendant, who did not ask for costs.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Watford U.D.C. has added £30 to the salary of Mr. W. S. Stafford, station superintendent, during the month of November, in consideration of services rendered by him as acting chief engineer prior to the appointment of Mr. Purse.

Mr. L. G. Butler, of Plumstead, has been appointed by Woolwich Borough Council junior charge engineer on probation for three months, at a salary of £90 per annum. At the completion of the probation Mr. Butler's salary is to be increased to £100 per annum, rising by annual increments of £10 to £140.

General.—The staff and employés of Messrs. Willans and Robinson, Ltd., Rugby, have presented a Queen Anne silver tea and coffee service to Mr. C. Morehead, who is leaving the firm, with whom he has been for over 20 years.

Mr. W. H. Hebod (late of Messrs. Lundberg & Sons) has joined the staff of Mr. G. Wuthrich, manager and chief engineer of the British, Irish and Colonial department of the Oerlikon Co., Oswaldestre House, Norfolk Street, Strand, W.C.

NEW COMPANIES REGISTERED.

Permanent Way Institution (Incorporated) (99,838).—This company was registered on October 9th, with 900 members, each liable for 10s. in the event of winding up, to promote among inspectors of Ways and Works a technical knowledge of the construction and maintenance of the works under their charge, to diffuse general knowledge of the qualities and strength of materials used on railway works and the best methods of testing their fitness for use, to promote acquaintance with the different kinds of permanent way, signalling, and other works and systems of maintenance adopted on British and foreign lines, to assist engineers and others in finding competent and experienced inspectors, gangers, foremen, and other skilled workmen. The word "Limited" is omitted from the title by licence of the Board of Trade. The first seven subscribers are:—W. Willox, M.A., M.I.C.E., 32, Westbourne Terrace, W., chief engineer, Metropolitan Railway; J. B. Bull, M.I.C.E., assistant engineer, Great Central Railway New Works, Marylebone Station, W.; R. Booth, A.M.I.C.E., North British Railway Co., 23, Waterloo Place, Edinburgh; G. T. Sibbering, Alteryn, Newport, Mon., chief engineer, Taff Vale Railway, Cardiff; J. H. Hargrave, M.I.C.E., 4, Haddington Terrace, Kingstown, Co. Dublin, chief assistant engineer, G.N.R. (Ireland); J. W. Poysen, Melton Villa, 22, Park Street, Stapleford, Notts, permanent way inspector, Midland Railway; S. E. Packham, 2, "Bryn-y-Mor," Lionel Road, Tonbridge, Kent, electrical inspector, S.E. and C.R. The management is vested in a council. Secretary, Stamford E. McLewin (signal department, S.E. and C. Railway, Battersea, S.W.), 74, Faversham Road, Catford Hill, S.E.

Penrith Electric Supply Co., Ltd. (99,764).—This company was registered on October 5th, with a capital of £7,000 in £1 shares (3,500 5½ per cent. cumulative preference), to acquire the benefit of the Penrith Electric Lighting Order, 1900, to adopt an agreement with the Penrith Urban District Council, and to carry on the business of an electric light and power supply company. The subscribers (with one share each) are:—W. P. Theermann, 269, Oxford Road, Manchester, electrical engineer; H. Fox, 44, Windsor Road, Doncaster, electrical engineer; J. W. Speight, The Elms, St. Anne's-on-the-Sea, consulting engineer; P. H. Whittaker, 46, Abingdon Street, Blackpool, C.E.; H. L. J. Butler, 2, Castlegate, Penrith, electrical engineer; W. A. Turner, 2, Castlegate, Penrith, incorporated accountant; P. Fox, 12, Wrayfield Avenue, Shipley, architect. Minimum cash subscription 25 per cent. of the shares offered to the public; the number of directors is not to be less than three or more than seven; the first are W. P. Theermann, H. Fox and J. W. Speight; qualification, 200 ordinary shares. Registered office, 3, Castlegate, Penrith, Cumberland.

Ship Carbons, Ltd. (99,812).—This company was registered on October 7th, with a capital of £1,000 in £1 shares, to sell in the United Kingdom (and not elsewhere) carbons, incandescent lamps and other electro-technical articles, &c. The subscribers are:—M. P. Schiff, partner of Schiff & Co., Schwechat, Austria, 994 shares; J. P. Schiff, 200, Alleegasse, Vienna, 1 share; E. Ornstein, Schwechat, Austria, 1 share; A. Merle, Schwechat, Austria, 1 share; Dr. O. Thorsch, Vienna, Imperial Councillor, 1 share; R. Guth, Hybernergasse 20, Prague, branch manager, 1 share; Dr. H. Singer, Vienna, barrister. The number of directors is not to be more than three: The first are M. P. Schiff, E. Ornstein and Dr. O. Thorsch (all permanent). M. P. Schiff is chairman. Each share confers one vote. The directors are given the customary powers of borrowing on debentures or other security, or without security, the clause concluding:—"but such moneys shall be borrowed or a security given to the said Maximilian Paul Schiff and no other person or corporation." Registered office, 67, Aldersgate Street, E.C.

Private Telephone Co., Ltd. (99,823).—This company was registered on October 8th, with a capital of £1,000 in £1 shares, to acquire the business of a company of the same name (incorporated in April, 1903, and now in voluntary liquidation), and to carry on the business of electricians, electrical engineers, manufacturers of, and dealers in, electrical apparatus, &c. The subscribers are:—M. Atkinson, Oakfield, Highgate Avenue, N., engineer, 500 shares; Miss. F. E. Pittard, 148, St. John's Road, S.E., secretary, one share. Private company. The number of directors is not to be more than three; M. Atkinson is the first director, and may retain office while holding 100 shares. Registered office, 27, Chancery Lane, W.C.

With reference to the foregoing notice, we are asked to state that this is only a re-registration of the old company rendered necessary through the death of one of the directors.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Holloway Electric Supply Co., Ltd. (53,172).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Debentures dated 1900, securing £15,000; and charge dated 1907, securing indefinite amount (£2,300 outstanding on July 1st).

Morris-Hawkins, Ltd. (93,821).—Deposit of deeds dated September 3rd, 1908, to secure all moneys due or to become due to the London Joint Stock Bank, Ltd., 5, Princes Street, E.C, has been registered. Property charged: Certain freehold land and premises at Dagenham.

Electric Reduction Co., Ltd. (London).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Amount £3,000 (no particulars).

Westminster Electric Supply Corporation, Ltd. (27,061).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Mortgages or charges dated 1898 and 1899, securing £250,000.

Kensington and Knightsbridge Electric Lighting Co., Ltd. 26,193).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Mortgages or charges dated 1895 to 1900, securing £190,000.

Lancaster and District Tramways Co., Ltd. (27,701).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Mortgages or charges dated 1890 to 1900, securing £18,036 9s. 6d.

Chile Telephone Co., Ltd. (29,252).—This company's annual return, made up to July 30th, has been filed. 44,000 shares have been taken up out of a nominal capital of £250,000 in £5 shares. £220,000 has been received. Mortgages and charges: Nil.

Sunbeam Lamp Co., Ltd. (25,498).—This company's annual return was filed on July 18th, when 1,765 shares had been taken up out of a nominal capital of £75,000 in £10 shares. £10 per share has been called up on 908, resulting in the receipt of £9,080. £8,570 is considered as paid on 857 shares. Mortgages and charges: £8,800.

Brush Electrical Engineering Co., Ltd. (29,533).—This company's annual return, made up to June 30th, was filed on August 14th. 105,732 ordinary and 150,000 preference shares have been taken up out of a nominal capital of £489,512 in 74,268 ordinary shares of £1 each, 105,732 ordinary shares of £1 6s. 8d. each, and 150,000 preference shares of £1 6s. 8d. each. £1 6s. 8d. per share has been called up on 35,818 ordinary and 78,463 preference, resulting in the receipt of £152,794 13s. 4d. £188,601 6s. 8d. is considered as paid on 69,914 ordinary and 71,537 preference. Mortgages and charges: £250,000.

Guildford Electricity Supply Co., Ltd. (36,725).—Re-Issue on September 22nd of a £100 debenture, part of series of which particulars have already been filed.

Bray, Markham & Reiss, Ltd. (74,871).—This company's annual return was filed on September 9th, when 8,000 shares had been taken up and paid for in full out of a nominal capital of £20,000 in £1 shares. Mortgages and charges: Nil.

General Electric Tramways, Co., Ltd. (43,428).—This company's annual return was filed on August 21st, when 18,500 shares had been taken up out of a nominal capital of £50,000 in £1 shares. £18,500 has been received. Mortgages and charges: £15,000.

Electrical Power Storage Co., Ltd. (30,313).—This company's annual return was filed on August 10th, when 66 founders' and 12,592 ordinary shares has been taken up out of a nominal capital of £100,500 in 20,000 ordinary and 100 founders' shares of £5 each. £5 per share has been called up on 66 founders' and £4 per share on 3,132 ordinary, resulting in the receipt of £13,382 5s. 1d., including £474 5s. 1d. paid in advance of calls. Mortgages and charges: £10,000.

Aluminium Corporation, Ltd. (92,846).—A deposit of deeds on August 29th, 1908, to secure all moneys owing to Lloyd's Bank, Ltd., up to £26,200, has been registered.

Electromobile Co., Ltd. (London).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Charge dated 1906, securing £18,740.

Altrincham Electric Supply, Ltd.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Amount, £17,300 (no particulars).

British Columbia Electric Railway Co., Ltd.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Mortgage or charge dated 1897, securing £250,000.

General Electric Co., Ltd. (67,307).—This company's annual return was filed on August 6th, when 25,000 preference and 36,053 ordinary shares had been taken up out of a nominal capital of £800,000 in 40,000 preference and 40,000 ordinary shares of £10 each. £290,530 has been paid on 18,000 preference and 11,053 ordinary shares, and £320,000 is considered as paid on 7,000 preference and 25,000 ordinary shares. Mortgages and charges: £200,000.

CITY NOTES.

Cape Electric Tramways, Ltd.

The report of the directors for the year ending June 30th, 1908, shows that the profit and loss account, after providing for debenture interest and redemption of debentures, and taking into account the balance brought forward from last year, shows a balance to credit of £8,823, which has been carried forward. During the year, the tramways carried, in Cape Town, 14,742,155 passengers, earning £120,910, against 12,563,303 passengers, earning £131,594 during 1906-7. In Port Elizabeth during the year 3,561,211 passengers were carried, earning £37,048, against 3,676,035 passengers, earning £39,696 for the year 1906-7. The business of the company, both in Cape Town and Port Elizabeth, has continued to suffer severely on account of the general depression and shrinkage of population of both towns; to this must be added the persistent ruinous competition which the company has had to undergo from the Government and the Sea Point Municipality, affecting the Sea Point section of the Cape Town tramway system. The earnings of the Sea Point Railway, the company's competitor, which is run by the Government under a guarantee of the Sea Point Municipality, continue to show heavy losses owing to the extremely low fares ruling on that line. On May 11th in this year, the company made an advance in its tariff on the Sea Point section, which, although it was followed by a temporary falling off in the passenger figures, has since been justified by results. During the year under review the then Cape Ministry went out of office, but their successors have taken no steps to put an end to the unfair competition of the Sea Point Railway, or to collect from the Sea Point Municipality the large sum owing to them for loss in running the railway, and which tends to increase the heavy burden already borne by the taxpayers of the Cape Colony. During the year, the board, in conjunction with the general managers of Cape Town and Port Elizabeth, have continued successfully to restrict expenditure in every direction as far as this is compatible with maintaining the thorough efficiency of the systems. The

tramways, both in Cape Town and Port Elizabeth, have been remarkably free from serious accidents during the year, and the claims for both systems arising under this head have not exceeded in all the sum of £238, which is a satisfactory testimony to efficient management; and the directors are satisfied that the general managers in Cape Town and Port Elizabeth, and the staffs under them, have been and are using every endeavour to further the general prosperity of the company.

Monte Video Telephone Co., Ltd.

The directors' report for the year ending July 31st shows that there has been a substantial increase in the number of subscribers and in gross revenue, but owing to an increase in the rate of wages, to damage caused by storms and the removal of lines necessitated by the introduction of electrical traction, the working expenses have more than absorbed the increased receipts. The net profit for the above period, after providing for such exceptional expenditure and ordinary working expenses in Monte Video and London, is £19,401, as against £20,384 for the previous year. The interim dividends paid on May 1st last required the sum of £4,343. To the balance, £15,058, should be added the sum of £3,081 brought forward from last year, making the balance now available £18,139. After transferring £6,000 to reserve fund and £5,000 to reserve renewal of plant, the directors recommend the payment of final dividends of 2½ per cent. upon the preference shares, and 3 per cent. upon the ordinary shares, making for the year 5 per cent. on the preference shares and 6 per cent. on the ordinary shares, leaving a balance of £2,797 to be carried forward. The directors regret to report that Mr. F. W. Jones, who has been chairman and managing director for so many years, finding that his health necessitates his residence abroad, has felt obliged to retire from board. The directors wish to record their high appreciation of his long and valued services to the company, and in recognition of such services an opportunity will be given to the shareholders at the meeting of voting him a sum of £500. Mr. Charles Lock has been appointed chairman. To fill the vacancy Mr. Laurence Richard Phillips, who represents large shareholding interests, has been elected to the board, and his election is, in accordance with the articles, submitted for confirmation. The board are glad to state that Sir John Gavey, C.B., late engineer in chief, and now consulting engineer to the Post Office, has consented to act as consulting engineer to the company. Owing to the expansion of the company's business, it is proposed to increase the directors' fees, which as at present fixed by the articles, are inadequate to the work involved. A resolution to this effect will be submitted at an extraordinary general meeting.

Drake & Gorham, Ltd.

Mr. B. M. Drake (chairman) presided at the offices, 66, Victoria Street, Westminster, on Thursday, October 22nd, over the annual meeting of this company.

In moving the adoption of the report (see Electrical Review, October 16th, page 665), the Chairman said they would have seen that the net profit on trading, amounting to £5,861, showed a marked recovery from last year's results. Before arriving at this figure liberal sums were written off for depreciation of stock. There was a considerable addition to stock in hand, which was mainly due to the development of their tantalum and Osram lamp agencies. These lamps being made abroad, it necessitated them carrying considerable stocks. The rate at which these lamps were replacing the carbon-filament lamps was remarkable, and he had little doubt that their use would become almost universal, owing to the large saving in current which they effected. These lamps had an important bearing on their business, as they could now light country houses at a largely reduced outlay and less working cost, which enabled them better to compete with other systems of illumination. Now that the use of metallic lamps had reduced the working cost of electric light to about 2d. per 1,000 c.p. per hour, there was no reason why anyone should not adopt the most scientific, the safest, and the most convenient form of light. The motor-car business in this country had been less brisk than during the previous year, and they had naturally felt the effects of this. They had, however, bought and tested a number of cars for clients who were glad to avail themselves of their services where they had not technical knowledge themselves, especially in view of the fact that these services cost them nothing. The year's work included the following: Remodelling the entire installation at Kensington Palace (for H.R.H. Princess Louise), Lambeth Palace, Westminster Cathedral and Manchester Cathedral; also additions at Eaton Hall for the Duke of Westminster; a large installation for Lord Ellesmere, supplying current to the new Hall, containing 1,100 lights, as well as to Lord Brackley's house, with 250 lights, an electric passenger lift, and the electric driving of a quantity of farm machinery. They had also modernised the installation at Yester House for the Marquis of Tweeddale, and put down a modern installation with suction gas plant for Lord Joicey at Ford Castle. Work had also been done for Lord Cranbrook, Lord Powis, Lord Kensington, Lord Marchamley, Lord Leith of Fyvie, Lady Cowper, Lady Stewart, Lady Boughey, Sir Reginald Hardy, and many others whom he named, also the Imperial Tobacco Co., Commercial Union Assurance, the complete remodelling at the Lancashire and Yorkshire Bank head offices, lighting at the London and County Bank and others. The electric driving and lighting of Messrs. Porritt Bros. & Austin's factory had been completed, and also the electric power scheme for Messrs. Joshua Hoyle & Sons at their mills, Summerseat, near Bury. For Messrs. Ashworth, Hadwen & Co. they put down a 1,000-h.p. electric transmission plant in their cotton mills. They had obtained contracts for the lighting of Ickworth, for Lord Bristol; Bicton, for Lord Clinton; and had work in hand for Sir Edward Every, Sir J. Kelk, Sir E. Mann, Sir W. Portal, Lady Wantage and many others. They were also carrying out for Mr. Paul Waterhouse, architect, a large installation at the Refuge Assurance Co.'s head offices in Manchester, which would consist of about 2,500 lights. The factory had justified its existence, and, in addition to manufacturing for the company's own requirements, switchboards had been made for Buckingham Palace, new public offices, Maidstone Corporation, Buxton District Council, Bristol Tramways and others. They were also making a considerable exhibit at the Manchester Electrical Exhibition, the expenditure on which they considered necessary in order to keep their name in evidence.

Mr. John C. Forster seconded the motion, which was carried without discussion.

Meldrum Bros., Ltd.—Under a compulsory winding-up order made against Messrs. Meldrum Bros., Ltd., of Manchester, Timperley Junction and elsewhere, the accounts show total liabilities £44,000, and assets valued at sufficient to yield a surplus of £9,605 after payment of all debts. The deficiency to the shareholders, however, is estimated at £114,611. Mr. H. M. Winearls, official receiver, reports that for several years prior to the registration of the company, Messrs. Meldrum had business relations in Paris, and in March, 1903, the Société Meldrum was registered to carry out the contracts of the vendors in France, Belgium and Switzerland. The extension and development of the French business was considered of the greatest importance, as until a few years ago destructors were quite unknown in France. The Société Meldrum has been financed throughout by this company, and is now a debtor to the latter for £51,964. It is now in liquidation in France, and the directors of this company place no value on their claim. For some years after the formation of Meldrum Bros., Ltd., its business was generally successful, and dividends were paid up to 1905. The failure of the company is attributed by the directors to increasing competition and to the heavy cost of establishing the business in France. In the opinion of the Official Receiver, however, the position is largely due to the failure of the Société Meldrum to reduce its debt and the consequent locking-up of the company's working capital. The Court has appointed Mr. Theodore Gregory, 3, York Street, Manchester, to be the liquidator with a committee of inspection.

Western Telegraph Company, Ltd.—The directors, after transferring £110,000 to the general reserve fund, £5,000 to the maintenance ships' reserve fund, £10,000 to the marine insurance fund, and £10,000 to the land and buildings depreciation fund, have decided to recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended June 30th, 1908, and also the payment of a bonus of 2s. per share, both free of income-tax. The balance of the account is carried forward. For the purpose of paying the above dividend and bonus on November 12th, the register of transfers will be closed from November 3rd to 11th.

Electrolytic Alkali Co.—The report for the year ended August 31st shows, after allowing debenture interest, depreciation, renewals, &c., a net profit of £10,411, increased by the balance from last year to £17,252. There is three years' dividend due on the preference shares, and the directors propose to pay one year's dividend and carry forward £10,255. According to the *Financial News*, the directors consider that, in view of the low prices for products and the high prices for raw materials, the results are satisfactory, and prove that, in normal times, substantial profits can be earned.

Parsons Marine Steam Turbine Co.—The report to June 30th shows a profit on manufacturing and from royalties, &c. (after providing for depreciation on buildings, plant, machinery, and office furniture, &c.), of £20,236. Adding the sum brought forward, the amount available is £31,370, and the directors recommend a dividend at the rate of 10 per cent., free of income-tax, carrying forward £10,242.

Rosario Electric Co.—Mr. W. T. Western presided at this company's meeting held at River Plate House, E.C., on Tuesday, and, in moving the adoption of the report, said that they were able to pay an 8 per cent. dividend on the ordinary shares, putting £5,000 to reserve and carrying forward £6,500. The business was making continuous progress, and next year they might have to increase their capital. Street lighting was being developed in Rosario, and "wire" lamps were being experimentally tried therefor. The gross receipts of the undertaking for the year were £73,100, as compared with £64,300 in the preceding period.

Pataling Rubber Estates Syndicate.—The directors have paid an interim dividend at the rate of 25 per cent. per annum (2s. 6d. per share), less income-tax, for the past half-year.

Selangor Rubber Co., Ltd.—The directors announce an interim dividend for the six months ended June last at the rate of 50 per cent. per annum, being 6d. per share, less income-tax.

Held Over.—Owing to pressure upon our space, reports of several company meetings have had to be held over until next week.

MARKET QUOTATIONS.

Wednesday, October 28th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	23/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£38 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£21	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£23 10	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	5½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	9½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	..
a Shellac	per cwt.	100/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Chlorate	per lb.	8½d.	..
a ,, Crystals	per ton	£9 5	..
a Sodium Bichromate, casks	per lb.	5d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£80	..
b ,, Wire, in ton lots	per ton	£150	..
b ,, Sheet, in ton lots	per ton	£128	..
c Babbitt's metal ingots	per ton	£50 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	7⅞d.	¼d. inc.
c ,, Tube (brazed)	per lb.	8¼d.	..
c ,, ,, (solid drawn)	per lb.	7¾d.	..
c ,, Wire, basis	per lb.	6⅞d.	¼d. inc.
c Copper Tubes (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn)	per lb.	9¼d.	..
g Copper Bars (best selected)	per ton	£74	£1 inc.
g Copper Sheet	per ton	£74	£1 inc.
g ,, Rod	per ton	£74	£1 inc.
c ,, (Electrolytic) Bars	per ton	£63 10	£1 inc.
c ,, ,, Sheets	per ton	£79 10	£1 inc.
c ,, ,, Rod	per ton	£68 10	£1 inc.
c ,, ,, H.C. Wire	per lb.	8¼d.	¼d. inc.
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
k India-rubber, Para fine	per lb.	4/3	3½d. dec.
i Iron Pig (Cleveland warrants)	per ton	48/6	2/8½ dec.
l ,, Wire, galv. No. 8, P.O.qual.	per ton	£14	..
g Lead, English Ingot	per ton	£18 10 to £18 15	inc.
m Manganin Wire No. 36	per lb.	8/-	..
g Mercury	per bot.	£8 9 to £8 10	inc.
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/1½	..
p ,, rolled bars & rods	per lb.	1/2 to 1/8	..
p ,, ,, strip & sheet	per lb.	1/2½ to 1/5	..
o Platinum	per oz.	..	..
e Silicium Bronze Wire	per lb.	2d.	..
r Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	per ton	£131 10 to £132 10	10/- inc.
n ,, Wire, Nos. 1 to 18	per lb.	1/9	..
p White Anti-friction Metals—			
"White Ant" brand	per ton	£34 to £38	..
k Zinc, Sh'd (Vieille Montagne bnd.)	per ton	£24 5	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a Special Settling Day in—

Singapore Electric Tramways, Ltd.—400,000 shares of £1 each, fully paid, Nos. 1 to 400,000; and £350,000 5 per cent. debentures of £100 each, Nos. 1 to 3,500.

The Committee has appointed a Special Settling Day as under—

Thursday, November 12th.—Marconi's Wireless Telegraph Co., Ltd.—124,908 7 per cent. cumulative participating preference shares of £1 each, fully and partly (10s.) paid, Nos. 500,001 to 624,908; and 173 7 per cent. cumulative participating preference shares of £1 each, fully and partly (5s.) paid, Nos. 624,909 to 625,080.

And to allow the following securities to be quoted in the Official List—

Kaministiquia Power Co., Ltd.—$1,325,000 30-year 5 per cent. gold bonds, Nos. 1 to 825 of $1,000 and A 1 to A 1,000 of $500 each, in lieu of the scrip now quoted.

Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd.—Further issue of £19,210 4 per cent. debenture stock.

Shawinigan Water and Power Co.—Further issue of £154,100 4½ per cent. perpetual consolidated mortgage debenture stock.

STOCKS AND SHARES.

Tuesday Afternoon.

Affairs in the Balkan Peninsula having quieted down to some extent, the Stock Exchange markets are relieved of immediate tension from that quarter, although a watchful eye is kept open for further possible complications. It cannot be said, however, that business has increased or that prices have derived much advantage—except of a purely negative kind—from this consideration, and a further fall in the funds formed a bad advertisement for investment markets generally.

The most interesting feature of the electrical markets at the moment is the dispute that has arisen in connection with the Mexican Light and Power and the Mexico Tramways Companies. It had been supposed, as mentioned here several weeks ago, that the Tramways would take over the Light and Power concern, and the terms upon which it would do so were declared to have been definitely arranged. The latter company was to receive a guaranteed dividend of 4 per cent., plus an additional share in certain circumstances. Now, however, the deal is declared "off," and the friendly agreement is supplanted by active rivalry.

It follows, as the night the day, that prices have fallen. The declines range from 1 to 3½ points, which is very little, in view of the steady rise which had occurred previously, and a rally lifted quotations well above the worst. Shrewd observers refuse to credit serious trouble arising between two undertakings that might be so mutually helpful, and there are reports that some kind of a compromise is already in course of preparation. Rumour goes so far as to say that the terms of the new arrangement will be even more favourable to the Light and Power Company than were those originally suggested, but such a statement deserves to be treated with suspicion; it is so extremely inartistic.

Rio Tramway shares are better at 67¼, and Sao Paulo Trams hardened to 155. Other South Americans have been firm. Anglo-Argentine Second Preferences show improvements. The Buenos Ayres Grand National group is steady. In the other hemisphere, Cape Electric Trams have risen from 5s. to 7s. 6d.; while in the domestic department, Metropolitan Tramways Preference gained another diminutive fraction.

Home Rails are a dull, despondent market, neglected and melancholy. Metropolitan Consolidated and Surplus Lands stocks are both lower, Districts shed ½, and Central London Ordinary, at 69, is 1 down. The new Tube 4 per cent. Debenture stocks continue to attract a good deal of interest, and in Charing Cross, Euston and Hampstead there are frequent dealings, the price now being about 86. Great Northern, Piccadilly and Brompton is 93, only a point below the price of Baker Street and Waterloo.

The old profit-sharing notes of the Underground Electric Railways of London are replaced by the new securities, of which the 5 per cent. Prior Lien bonds are 93, the 4½ per cent. bonds of 1933 are 75½, and the 6 per cent. Income bonds 23.

Further Parliamentary discussion of the Electricity Bill has produced no more effect upon the market in the shares, and transactions remain as few as ever. St. James's and Pall Mall Preference rose ¼, and Charing Cross Ordinary shares are ⅛ better; these were the only movements amongst the list of London shares. County of Durham Preference are ¼ down, and Newcastle-on-Tyne shares have suffered somewhat sharply. River Plate Electricity Ordinary, in common with other Argentine issues, have been stronger.

In Telegraph stocks and shares there is little doing. Western Telegraphs are ⅛ easier, and Anglo-American Deferred lost an equal amount, although the Presidential campaign in the United States ought to be a good thing in keeping the cables well occupied. Great Northern Telegraphs are 10s. better. Globe Telegraph and Trust Preference continue to dwindle, and a slight pressure to sell is said to be on behalf of a deceased account.

National Telephone issues show a tendency to weaken, the Deferred being 1 lower and the Third Preference ⅛ down. Egyptian Telephone Debenture has advanced to a premium.

The India-Rubber, Gutta-Percha and Telegraph Works Co. is offering its present shareholders the right to apply for 12,500 cumulative 5 per cent. Preference shares at their par value of £10 each. A premium of ⅛ to ⅜ has been established on these new shares. The Ordinary are quoted *ex* rights. British Aluminium have come down again. Willans & Robinson Ordinary fell to about 15s., and at 52s. 6d. the Preference are also lower.

Consolidated Malay Rubber Estates, Ltd.—The directors announce an interim dividend of 5 per cent. for the six months ended June 30th last.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations Oct. 20th.	Closing Quotations Oct. 27th.	Business done week ended Oct. 27th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2⅛ — 3⅛	2⅛ — 3⅛	..	..	..	Nil.
186,700	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 7 6
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7¼%	7½%	8 %	8 %	129 —133	129 —133	..	..	..	6 0 4
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
598,180	Anglo-American Telegraph	Stock	28%	31%	37%	34%	58 — 61	58 — 61	..	..	..	5 14 9
3,200,910	Do. do. do. 6 % Pref.	Stock	5%	6 %	6 %	6 %	102 —103	102 —103	102⅜	102	..	5 16 6
3,200,910	Do. do. do. Deferred	Stock	Nil	½%	1%	1 %	16⅜ — 17⅜	16⅜ — 17	16⅜	..	— ⅛	5 17 8
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8 — 8¼	8 — 8⅛	8¼	..	..	4 14 1
2,883,376	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	88 — 90	88 — 90	89⅛	88⅜	..	4 8 11
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	7⅞ — 8⅜	7⅞ — 8⅜	..	..	..	6 17 2
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16¼ — 17½	16¼ — 17½	..	..	..	5 13 6
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3 — 3⅛	3 — 3⅛	..	..	+ ⅛	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	8 14 10
60,710	Direct United States Cable	20	3½%	4½%	4½%	4½%	13½ — 13¾	13½ — 13¾	13½	13½	..	6 2 6
53,700	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,300, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	135 —138	137	135	..	5 1 5
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	84 — 86	84 — 86	85⅜	84	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	104½	..	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜ — 13⅛	12⅜ — 13	12⅝	12⅜	— ⅛	5 7 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	102	101⅛	..	3 17 8
269,700	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99½—101½	99¼—101¼	..	..	..	3 18 10
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101½—103½	101¼—103¼	..	..	..	3 17 4
181,127	Globe Telegraph and Trust	10	5⅜%	5½%	5½%	5¾%	10⅝ — 11⅛	10⅝ — 11⅛	10⅝	10⅝	..	5 5 8
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13½ — 14	13⅝ — 13⅞	13⅞	13½	..	4 6 6
150,000	Great Northern Telegraph, of Copenhagen. ..	10	24 %	24%	20 %	20 %	29 — 31	29½ — 31½	30½	..	+ ½	6 6 0
24,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	56 — 59	56 — 59	57¼	..	..	5 6 8
$11,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	4 %	70 — 75	70 — 75	..	..	..	5 9 7
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	68 — 72	68 — 72	73	..	..	5 9 7
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅝ — ⅞	⅝ — ⅞	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	1 — 1⅛	1 — 1⅛	20/6	..	..	5 6 8
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	110	109	..	5 8 1
3,725,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	117½—119½	116⅝—118⅝	118⅝	116⅝	—1	5 1 3
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾ — 11¼	10¾ — 11¼	..	..	..	5 6 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10¾ — 11¼	10¾ — 11¼	..	..	..	4 8 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5½	5 7/16 — 5 9/16	..	..	..	4 7 1
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98 —100	97½ — 99½	98½	98	— ½	8 10 4
1,716,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	102 —104	102 —104	102½	..	..	3 16 11
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6½%	7 %	7 %	8 %	1⅜ — 1⅝	1⅜ — 1⅝	25/6	25/3	..	5 16 4
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	4 16 0
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	..	4 %	4 %	4 %	89 — 92	90 — 93	..	..	+1	4 6 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 —103	100 —103	101½	..	..	3 17 8
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	4½%	99 —102	100 —103	..	..	+1	4 7 5
3,083	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
100,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅝ — 7⅛	6⅝ — 6¾	6⅞	..	..	5 16 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5 1/16	..	..	4 10 11
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	2½%	2½%	1¼ — 1⅜	1¼ — 1⅜	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13⅜ — 14½	13½ — 14	14	13½	— ½	5 0 0
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..	3 16 11
68,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	7/16 — ⅛	7/16 — 11/16	..	..	..	Nil
34,553	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	6 %	8 — 8½	8 — 8½	..	..	..	7 1 2
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	£2 6	8½ — 9½	8½ — 9½	..	..	..	2 9 0
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

320,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	8 %	9 %	8⅜ — 8⅝	8⅛ — 8¼	8⅜	8 17/32	+ ⅛	5 2 10
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5⅛%	5⅛%	5⅜%	6 5/16 — 6 7/16	6 5/16 — 6 7/16	6½	6 13/32	..	4 10 3
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	141 —146	141 —146	..	..	..	4 2 2
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
880,000	Babcock & Wilcox, 1 to 880,000	1	20 %	20 %	20 %	20 %	3⅛ — 3 5/16	3⅞ — 4	77/6	75/-	+ 1/16	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1⅝	1⅛ — 1⅜	88/9	..	..	5 13 10
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	2⅛ — 2⅝	1¼ — 2⅜	61/3	..	— ⅛	14 14 8
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	3½ — 4	3 — 4	..	..	— ½	8 15 0
60,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4¼ — 4⅝	4 — 4½	..	..	— ¼	6 13 4
40,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3¾ — 4¼	3⅞ — 4⅛	..	..	..	4 14 1
12,897	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	106 —110	106 —110	..	..	..	4 10 11
43,473	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
800,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	8 %	135 —139	135 —139	137	136	..	5 15 1
400,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	117 —121	116 —120	..	..	—1	4 3 4
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	106 —110	106 —110	109	..	..	4 10 11
800,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 —103 xd	101 —103	..	..	..	10 17 6
233,000	Do. 4½ % Vancouver Power Debs., 1 to 2,300	100	4½%	4½%	4½%	4½%	101 —104	102 —105	..	..	..	4 7 0
220,000	British Electric Traction	10	6 %	3 %	Nil	Nil	⅞ — 1⅛	⅞ — 1⅛	18/9	17/6	..	Nil
133,301	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	3 %	3⅜ — 4⅛	3⅜ — 4⅛	75/-	73/9	..	7 1 2
161,437	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..	5 5 3
1,473,653	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	76 — 78	76 — 78	..	..	..	5 16 5
528,936	British Insulated and Helsby Cables	5	8 %	8 %	10 %	10 %	6½ — 6⅝	6½ — 6⅝	6½	..	..	7 8 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6⅛	6 — 6⅛	..	..	..	4 12 4
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
208,440	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	91 — 96	91 — 96	..	..	..	4 18 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	7/16 — ½	7/16 — ½	..	..	..	Nil
1,016,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	40 — 45	40 — 45	..	..	..	8 17 10
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	7/16 — 11/16	7/16 — 11/16	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	2½%	Nil	Nil	0— ⅛	0 — ⅛	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	6 3 3
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	68 — 73	68 — 73	..	..	..	8 6 0
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	50 — 54	50 — 54	..	..	..	5 11 8
137,610	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	6 %	5⅜ — 5⅝	4⅝ — 5⅛	5⅛	93/9	..	4 16 8
45,404	Do. 5 % Cum. Pref., Nos. 1 to 29,380..	5	..	5 %	5 %	5 %	4⅜ — 5½	4⅜ — 5½	97/6	95/-	..	4 4 11
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	7 2 10
35,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	15 %	9½ — 10½	9½ — 10½	..	..	..	5 6 11
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	5⅝	6½	..	4 2 2
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107⅞—109⅛	107⅞—109⅛	..	..	..	Nil
491,222	Cape E Trams., 1 to 491,222	1	5 %	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..	+ ⅛	7 14 10
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	12 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	31/6	31/-	..	4 4 1
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	105 —107	103 —107	..	..	..	4 5 9
1,898,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	69 — 71	68 — 70	6⅞	6⅞	—1	4 1u 11
553,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..	3 16 11
553,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	49 — 52	49 — 52	51⅞	51⅞	..	6 6 10
1,480,000	City and South London Railway	Stock	2½%	1¾%	2½%	2½%	32½ — 33½	32½ — 33½	33⅝	..	..	

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Oct. 20th.	Closing Quotations Oct. 27th.	Business done week ended Oct. 27th, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest.	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	£	2½%	2½%	5 %	5 %	1⅝— 1⅞	1⅝— 1⅞	..	..	..	9 10 6
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	98 —101	98 —101	..	..	..	4 19 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1⅞— 1⅝	1⅞— 1⅝	28/9	..	..	7 12 5
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	6 %	6 %	6 %	6 %	1 — 1¼	1 — 1¼	..	..	..	4 16 0
276,880	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	103	102	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6¼%	11½— 12½	11½— 12½	..	..	..	5 4 0
60,000	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½— 13½	12½— 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	2½%	4½%	4½%	4½%	⅜— ⅞	⅜— ⅞	13/9	13/6	..	18 2 0
17,189	Do. "A" shares, 01—017,189	5	2½%	4½%	4½%	4½%	1⅞— 2¼	1⅞— 2¼	..	..	..	8 6 9
317,875	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	76 — 79	76 — 79	..	..	..	5 1 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	84 — 87	84 — 87	..	..	..	5 14 11
112,100	Electric Construction, 1 to 112,100	2	4 %	Nil	Nil	Nil	⅞— 1⅛	⅞— 1⅛	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890..	2	7 %	7 %	7 %	7 %	1⅝— 1⅞	1⅝— 1⅞	..	..	..	8 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7¼— 7½	7¼— 7½	..	..	..	6 9 0
200,000	Do. do 4 % Mort Deb..	Stock	4 %	4 %	4 %	4 %	84 — 88	84 — 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	4 %	½— 1	½— 1	..	..	..	5 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½— 10¾	10½— 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —102½	102 —103	..	..	..	4 17 1
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15%	10½— 11½	10½— 11½	..	..	..	7 8 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 — 109	..	..	..	4 2 7
50,000	India-Rubber, Gutta-percha & Telegraph Works..	10	5 %	10%	10 %	10 %	16½— 17½	16½— 17½	17	16¾	..	5 14 3
37,500	†Liverpool Overhead Railway, Ord.	10	1¾%	Nil	Nil	¾%	1⅝— 1¾	1⅝— 1¾	..	..	..	4 0 0
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	9 1 10
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	3 %	3 %	3 %	6⅞— 6⅞	6⅞— 6⅞	..	..	..	4 8 11
899,980	Do. do. 60,008 to 100,000	10	6 %	3 %	3 %	3 %	6⅞— 6⅞	6⅞— 6⅞	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5 7/32	..	..	9 1 10
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	..	..	..	5 3 11
5,782,062	Metropolitan Consolidated	100	3 %	2¾%	1 %	¾%	38½— 39½	38 — 39½	38⅞	37½	— ½	1 5 7
2,640,914	Do. Surplus Lands	100	2¾%	2¾%	2¾%	2¾%	68 — 70	67 — 69	69	67½	— 1	3 19 9
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	13 — 14	12½— 13½	13⅜	12 13/16	— ⅛	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/32— 5/32	3/32— 5/32	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32— 3/32	3/32— ¼	16/-	..	..	5 19 5
823,800	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	..	..	..	4 14 9
248,500	Potteries E. Tre.	1	5 %	4 %	4 %	4 %	3/32— 5/32	1/32— 3/32	..	..	..	8 0 0
245,500	Do. 6 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32— 1/16	1/32— 1/16	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	..	..	..	4 14 9
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	32 — 34	32 — 34	33	..	..	6 18 8
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..	3 17 8
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	..	..	92½— 93½	..	..	..	..
2,800,000	Do. do. 4½% Bonds	..	..	..	..	..	..	75 — 76	..	..	..	..
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	..	22½— 23½	..	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	⅜— 1½ xd	¼— 1	1⅝-	..	— ⅛	10 0 0
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	2⅜— 3 xd	2⅜— 2¾	53/9	52/6	— ⅛	10 8 8
246,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 76	72 — 76	..	..	..	5 5 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5½%	5½%	4⅜— 4⅞	4⅜— 4⅞	..	..	..	5 11 5
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	96 —100	96 —100	..	..	..	4 10 0
30,275	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10%	10 %	7 — 8	7 — 8	..	..	..	6 5 0
9,725	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 — 102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	5 %	3⅜— 3⅞	3¼— 4	75/-	67/6	+ ⅛	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅞— 4¼	3⅞— 4¼	..	..	..	5 5 11
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾— 3⅞	3¾— 3⅞	67/6	..	..	6 0 0
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 10 11
49,436	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	4½%	2⅞— 3⅛	2⅞— 3⅛	..	..	..	6 13 4
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9½— 10	9½— 10	9⅝	..	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12½	..	..	4 12 4
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 15%) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	123⅜	..	..	4 0 0
300,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	102	101½	..	4 6 7
50,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	2 %	2⅜— 3	2⅜— 3	..	..	..	3 8 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3⅝— 4¼	3⅝— 4	..	..	— ⅛	6 5 0
200,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	..	99 —101	99 —101	..	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7 — 8	7 — 8	7½	..	..	6 5 0
50,026	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½— 10⅞	10½— 10⅞	10⅜	..	..	5 11 8
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	Nil	⅛— ¼	⅛— ¼	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	Nil	¾— 1	¾— 1	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	59 — 66	59 — 66	62½	..	..	6 16 4
$8,150,000	Electrical Dev.Co.of Ontario, 5% 1stMtg.Gold Bnds.	$500	..	..	..	..	83½— 85½	81 — 84	81½	81	—2½	..
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½— 5½	4½— 5½	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 11
15,000	Hove, 1 to 15,000	5	8½%	9 %	9 %	8½%	6 — 6½	6 — 6½	6½	6⅛	..	6 10 9
$1,325,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	..	94 — 96	94 — 96	95	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	10 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	3 %	4 %	4 %	2½%	⅞— 1⅛	⅞— 1⅛	20/-	..	..	5 8 1
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛— 4⅜	4⅛— 4⅜	99/6	..	..	6 9 9
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 92	89 — 92	..	..	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6¾%	4⅛— 4⅜	4⅛— 4⅜	..	..	..	6 16 10
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜— 4½	4⅜— 4½	91/3	87/6	..	4 12 4
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	105 —109	..	..	..	4 2 7
248,000‡	Do. 5 % Mort. Deben. Stock Redem.	Stock	5½%	5½%	5½%	5½%	84 — 89	84 — 89	..	..	..	5 18 8
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	89 — 90	86 — 88	88	86⅜	—2½	5 13 8
$18,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	..	77 — 78	74 — 76	76	69½	—2½	..
$1,500,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	..	112 — 113	109 —111	112	109½	—2	..
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	..	90½— 91½	88 — 90	91	88½	—1½	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	5⅛— 5⅜	4⅞— 5⅛	5⅛	..	— ⅜	7 8 10
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	— ⅜	4 8 11
10,859	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11½— 12½	11½— 12½	..	..	..	5 17 8
20,000	Oxford, 1 to 96 and 407 to 20,510	5	7 %	7 %	7 %	7 %	5⅝— 6⅛	5⅝— 6⅛	..	..	..	5 14 3
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 98	95 — 99	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	..	2½%	..	1⅜— 1½	1 3/32— 1 5/32	2⅜-	2⅜/9	+ 1/32	..
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6	6	6	6	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..	..
194,684	Do. do. 5% Deb. Stk. Red.	100	5	5	5	..	99 —102	99 —103	100¼	100	..	4 18 0
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7⅜— 8¼	7⅜— 8¼	7⅞	..	..	6 1 3
90,000	Do. do. 7 % Pref. 20,051 to 40,080	5	7 %	7 %	7 %	7 %	6¾— 7⅛	6¾— 7⅛	..	..	..	4 16 7
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	86 — 90	86 — 90	88	87½	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	⅛— ¼	⅛— ¼	..	..	..	Nil
46,700	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	68 — 72	68 — 73	..	..	..	5 11 1
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	2½— 2⅝	2½— 2⅝	..	..	..	7 5 5
130,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	⅛— ¼	⅛— ¼	..	..	..	4 0 0
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	6 4 5
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —101	99 —102	99½	..	+ ½	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	½— 1	½— 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅝— 2⅜	1⅝— 2⅜	..	..	..	10 10 6
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
800,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	..	⅝— 1⅛	⅝— ⅝	..	..	— 1/16	..
110,000	Westminster Electric Supply, Ord.	5	14 %	13 %	12 %	10 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	5 17 8
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	4½%	4½%	5 — 5½	5 — 5½	5¼	5⅛	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. ‡ Interim Dividend.

Bank rate of Discount 2½ per cent.. May 28th. 1908.

POWER TRANSMISSION BY ENDLESS BELTS.

By W. WORBY BEAUMONT.

The chief object of this paper is to renew attention to facts which are well known concerning the efficiency of belts used in power transmission, but to which little attention is paid in the practical world in which they are of importance.

To make things clear, it is necessary to restate briefly some well-known elementary theoretical points, although the chief object is to renew attention to the importance of high frictional adhesion between belt and pulley.

An endless belt is enabled to convey power from one pulley to another by its frictional adhesion to the surface of the pulleys.

The value or amount of this frictional adhesion is readily obtained in a simple manner—namely, by suspending weights from the two ends of an open belt on a fixed pulley, as in fig. 1.

Here the weight W is gradually increased until it is found that it will just balance the frictional adhesion of the belt on the

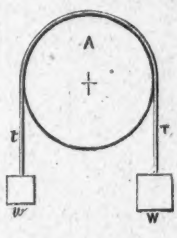

Fig. 1.

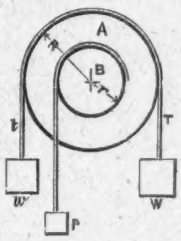

Fig. 2.

pulley A, and the smaller weight w, and the tensions in the two parts of the belt are respectively T and t. Any addition to either weight will cause it to descend and raise the other weight, overcoming the total friction F of the belt on the pulley surface. Here then—

$$W = w + F = T, \text{ and}$$

$$T = t + F \text{ and } F = T - t.$$

If now the pulley be made free to rotate, the weight w must be made equal to W for static equilibrium, and then $t = T$, and neglecting frictional influences any addition to either weight will cause the rotation of the pulley and the lifting of the other weight.

If the pulley be made to transmit power corresponding with a pull P, then the power transmitted by it will be in proportion to $P - t$ or to $T - t$, or to transmit the power corresponding to the pull P, the total tension in the pulling side of the belt must be $P + t$.

The case may be put more clearly by showing the pulley A carrying the belt and weights W and w and another pulley B, as in fig. 2, to which power is transmitted by it. Here the pulley is made to lift the load P by the descent of the weight W through the frictional hold of the belt on the pulley A maintained by the weight w. In this case the power available for lifting the load P at radius r is $T - t$ acting at the radius B, so that the mechanical conditions are $(T - t)\,B = Pr$ and $P = (T - t)\,\frac{B}{r}$.

Putting diagram fig. 2 in a form more resembling ordinary conditions of belt and pulley working, we have fig. 3. In this case the pulleys A and B are of equal diameter, and a resistance to rotation at the periphery of the transmitting pulley is represented

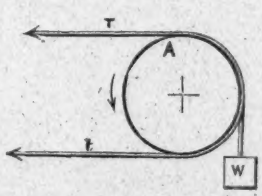

Fig. 3.

by a load P. The tension on the tight side T of the belt would then have to be greater than that of the pull by P, and would equal $P + t$, and with this the belt would be just about to slip on the pulley. Thus, no matter by what arrangement of the belt, the tension T in the pulling side of the belt must always be greater than the pull of the load P, although the resistance due to the latter is acting at the same radius as the belt.

When the belt is endless, as in fig. 4, it might appear that the initial tension, imposed in order to obtain frictional adhesion, would be a neutral tension on both sides T and t, because the tension acts equally on both the driving pulley A and the driven pulley B, and from this it would appear that the maximum tension T would equal the pull P. The maximum tension T is, however, $P + t$ when the belt is just on the point of slipping, because the condition necessary to F can only exist when $T = t + F$.

Fig. 4.

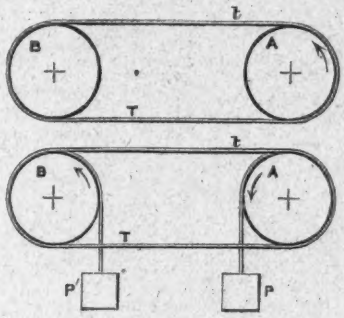

Fig. 5.

The general method of statement of this fact has led to a common misunderstanding which may be most easily illustrated by the following quotation from one of the most complete text-books on belt transmission of power.*

"The greatest strain brought to bear upon an endless belt, or the strain tending in the greatest degree to cause breakage is the tension in the driving part of the belt, that is T. This tension acts in one direction and the lesser tension t in a contrary direction. Consequently it is the excess of the greater over the lesser tension which overcomes the resistance of the pulley and causes rotation." In this there is the fundamental error of assuming that the tension t in an endless belt, as in fig. 4, acts in opposition to the tension T, whereas it is a neutral tension, the belt at the part t acting merely as a connecting link to enable F to be brought into existence and to enable, as a maximum, $t + F$ to equal T. From the statement in the foregoing quotation, it would be inferred that a force P exerted by the driving pulley A must be greater than the available force P, transmitted to the driven pulley B, in the proportion $P' = T - t$, or $P' + t$.

In fig. 5 two pulleys of equal diameter are placed side by side and fixed upon the shafts carrying them, the one pair carrying an endless belt and the others carrying belts suspending loads, P and P'. Here, in order to obtain the conditions which give the frictional adhesion F, there must be, as before, the conditions which give $F = T - t$ in order that $t + F$ shall equal the tension T necessary to the transmission of the force exercised by the load P to drive the pulley carrying the load P'.

Now that the tension t does not oppose in one or either direction the tension T in either direction is shown by the equality of P and P' whatever be the excess of $T + t$ above that required to give P necessary to the transmission of the force P by the frictional adhesion of the belt on the pulley. (In this statement the friction of bearings and the losses which occur in practice from various causes are neglected.)

In the foregoing, pulleys of equal diameter or in which the fraction of the surface embraced is 0·5 or 180° have been taken for illustration. With driving and driven pulleys of different diameters, the fraction of circumference embraced of the smaller pulley being less than 180°, the mean tension $\frac{T + t}{2}$ becomes larger, and rapidly increases with increasing difference in the diameters of the pulleys and decreasing distance between their centres. It is not necessary to deal with this point, as the relations between t and T in this respect have been fully set out in the text-books.

The point to which I would especially direct attention, and the chief object of this paper, is the necessity for increasing the frictional adhesion of belts on their pulleys and paying more attention to the value of maximum distance between centres of driver and driven pulley, and to minimum difference in diameters. In practice the coefficient of friction varies enormously, and insufficient attention is given to it, when the losses due to low coefficient of friction are considered.

Not only are stronger and heavier belts used than should be necessary, but the very heavy tension put upon them increases the frictional losses and troubles with bearings and the losses caused in the bending and straightening of the belts as they take their bearing upon and leave the pulleys.

In many cases the coefficient of friction is so low that for a useful or effective pull P upon the belt, the tension $T = P \times 1{\cdot}4$, or with $P = 600$ lb. $T = 840$ lb., or an excess stress in the belt of 40 per cent. over the effective tension with pulleys of which 180°, or 0·5 of the circumference is embraced, and this becomes 68 per cent. when only one-third of the circumference is embraced.

Belts have thus quite commonly to be from 20 to over 100 per cent. stronger than would be necessary if the coefficient of friction were unity, instead of the mere fraction which is common with smooth bright pulleys and belts in a hard smooth condition.

A coefficient of 1·0 is impossible, but a clinging condition of belt surface has often been obtained in which with pulleys of the same,

* "Belts and Pulleys," by J. H. Cromwell.

or approximately the same, diameter, the difference $T - t$ is very large, and the difference $P - T$ is correspondingly very small.

Various methods of increasing F, as, for instance, the use of perforated pulleys and leather-covered pulleys, have been tried, but their use has not been persisted in. Preparations for coating pulleys have been used, but these though quite successful for a time have gone out of use, apparently because of the necessity for renewal. Careful and persistent treatment of belts with castor oil or some preparation of oils has been most used, and in many cases of short belts and limited widths this has been forced upon users because otherwise the belts would not do the work required. Paper-covered pulleys or paper preparations for coating them have also been proposed. For some reason or reasons, however, few or none of these means of increasing the frictional adhesion of the belt upon the pulley have been generally pursued, and it seems remarkable that, considering the great saving that might be made per year in any large factory, this should be the case. Power transmission by means of belts is, in a vast number of cases, a preferable method, because of its simplicity, smoothness of action, useful slight flexibility, and silence. Where, however, the coefficient of friction between belt and pulley is allowed to be so very low as it is in very many cases, and the stress upon the correspondingly tight belt so disadvantageous as to first cost, and more so as to costs of working, the advantages are dearly bought, and in many cases the modern well-made light drive chains with which $P = T$ would be preferable.

THE ALLEGED SECRET SYNDICATE IN THE GERMAN ELECTRICAL INDUSTRY.

Is Competition Suppressed?—A Reply on Behalf of One of the Syndicated Works.

The excessive competition which prevails in the United Kingdom in order to secure contracts of all kinds, whether the monetary value involved be small, medium or large, forms a marked contrast to the position of affairs in Germany at the present moment. At the same time it is essential not to overlook the fact that the greater portion of the inland trade in that country must naturally be vested in the hands of the three leading groups, having regard to the magnitude of their undertakings, which maintain representative organisations of one kind or another throughout the empire for the purpose of dealing with local orders or contracts which may be thrown open to the trade. It will, therefore, be understood that the local representatives or agencies of the groups enter into rivalry both with the local firms and with other firms engaged in the industry that may enter for the work. Of course, every firm, great or small, has a perfect right to endeavour to secure business in contest with others, but complaints have been made in the past year or two, particularly by a manufacturing firm at Cologne, that the leading works are endeavouring to monopolise the whole of the trade by a system of co-operation or by the operation of a secret understanding or agreement.

The specific charge made by the Cologne firm in July, in the course of a statement placed before the Statistical Board of the City of Cologne, was that the large companies arrange for the submission of high prices when they believe that they alone will be asked to tender, and that they agree as to which company should present the lowest offer in order to obtain the order. On the other hand, according to the statement, if the large companies are aware that other firms will be asked to compete, they tender at low prices or offer to the small firms a certain percentage on the estimated value of the contract, in order that the latter may abstain from the business, or fix a higher price than the projected cheapest offer. It is unnecessary for us to state whether the charge is untrue or well founded, although details of a remarkable competition in prices were published in the Review a year or two ago. All that it is necessary for us to do is to mention that an arrangement, understanding, or agreement, has existed between the large manufacturers for a long time, in connection with the handling of business in which competition is expected.

The existence of the agreement has also been no secret in Germany for a long time past, but the details have been kept from publicity until recently, and they would not now be available, were it not for the circumstance that a copy—perfect or imperfect, quite immaterial—has, by some means or other, apparently found its way into the offices of certain newspapers, as, for instance, the *Berlin Tageblatt*, the *Kolnische Zeitung* and the *Frankfurter Zeitung*. That the agreement is in operation is also admitted on behalf of one of the firms concerned, and there should therefore be no objection to the reproduction of the particulars, especially as those firms which are outside its scope are declared to have the same opportunity of associating themselves with it at the present time if they choose to do so. In these circumstances, we set forth, in the first place, the most important features of the agreement, as published by the German newspapers in question, and secondly, the reply given on behalf of one of the leading groups participating in the agreement.

It is necessary to mention that the extracts from the agreement bear evidence that they represent instructions given to representatives or agencies of the interested groups, and they must consequently be read in this light. The agreement, which appears to be divided into two sections, relates to what is termed protected business in regard to dynamos, motors, transformers, switchboards, &c., and in connection with which one firm is predetermined to receive the order, if possible, and the others support it against rivals. The extracts are as follows:—

Regulations for the Treatment of Protection Business.

Each scheme becoming known to you of the value of £500 or over, is to be intimated to us on the day of its announcement. If estimates have to be submitted, a distinction must be drawn between preliminary projects and definite projects. The former class is represented by those which are to serve as the foundation for calculations of the remunerativeness, for the granting of money or for similar purposes, on the basis of which, however, the placing of the order is not yet to be expected. Those inquiries are only to be considered as definite schemes in which definitely binding offers are requested, on the basis of which the bestowal of the order for the installation is expected in a few months at the latest. In the case of inquiries amounting to £1,000 and over, offers are in no case to be sent in before the receipt of instructions from the parent house, not even if preliminary projects are in question. No offers also are to be submitted without the instruction of the parent house for inquiries of from £500 to £1,000, if the inquiries refer to installations in connection with which a protected firm has hitherto exclusively, or almost exclusively, effected the deliveries.

Inquiries for business of less than £500 are also to be communicated when they refer to extensions of installations for which a protected firm has hitherto exclusively, or almost exclusively, delivered, or for which protection was once arranged for, as we wish in the interest of price maintenance to strive for protected agreements. Also in these instances preliminary projects are only to be tendered for at such high prices that no subsequent protection agreements are forestalled through the prices quoted, and the prices are not to be more than 10 per cent. below list prices; and in case of eventual difference of opinion the firm working out the preliminary project has to produce the proof. The apportionment of the individual orders takes place having regard to the deliveries hitherto effected, the bank connections, the personal and business relations and the wishes of customers, as well to the preliminary work carried out. In general only deliveries in the past ten years, with special consideration for those made in recent years, will be taken into consideration as "deliveries hitherto," and the deliveries of a firm are deemed to be only those effected directly or through official representatives.

Normal Protection.

A distinction in protection agreements is made between normal protection and price level protection. Normal protection is equivalent to the renunciation of the transaction concerned by the protecting firms; the protection is to be exercised with a minimum of 5 per cent., and it extends both to principal items and the final sum. In every case the protection is to be exercised in such a way that the interested party, whether he be a layman or expert, gains the impression that the project submitted by the protected firm is the most advantageous to him. The pursuit of protected business by the protecting firms has only to take place in cases of normal protection in so far as it is necessary to veil the protection. "Technical acquisition" so as to get in orders at protection prices is inadmissible.

If with normal protection the price of an outside firm limits a protecting firm, the latter has to inform the parent house immediately of the position of the limit, in order that the parent house can arrive at an understanding with the protected firm in regard to acceptance or refusal. The fixing of the limit must be effected in such a form that in case of the eventual acceptance, for which the express sanction of the parent house is necessary, the order is perfect. With normal protection, the protected firm is justified in granting eventual reductions, of which no communication to the protecting firms need be made. If, however, reductions are also suggested to a protecting firm, the concessions made by the protected firm are to be intimated to the former on inquiry, and the protecting firm is then justified likewise in giving way in prices, although only in so far as the percentage of protection agreed upon remains in existence. In the case of low offers from outside contractors the protected firm is to be facilitated in fighting them as far as possible in the sense that if the protecting firms are approached in respect of price concessions, they are not to give way to the same extent as the protected firm, and thereby increase the difference between the protected and protecting offers.

Price Level Protection.

Under this term is to be understood protection in which only slight differences in prices of from 2 to 3 per cent. are arranged. Such arrangements are made in relation to an order when several firms have equal chances and equal rights to secure the business, so that a decision in the favour of the one firm or another cannot be made. In this case, if normal protection cannot be effected as an alternative, the submission of approximately the same prices will be arranged, and in order not to send in equal tenders an agreement or lottery is to decide which firm is to be the cheapest, and which is to be 2 or 3 per cent. higher, as well as the firm which is to determine the price basis. If low outside offers arise under price level protection the cheapest firm is to reduce its prices correspondingly, although in this case an understanding as to the reduction is to be at once arrived at with the other firms. Reductions are, however, to be avoided as far as practicable in order to prevent depression in prices as much as possible, and a lever for the obviation of depression is afforded to the firms by the authority to adopt a limit. Tenders for works for which price level protection has been arranged are only to be sent in after mutual declaration of understanding, and an understanding is also to

be effected as far as possible about the technical working out of the project from the beginning.

The system of price level protection is, moreover, to come into consideration only in actually inevitable cases, and is consequently to form the exception; whereas normal protection has to be regarded as a rule in the interest of a simplified course of business and for the avoidance of differences. With the price level protection each office is allowed to accept a limit without re-inquiry of the parent house, at the prices of the protection firm which has presented the lowest offer in the case concerned, the presumption being that the order is settled by the acceptance of the limit. Any one of the protection firms can only accept a limit placed upon it at a lower price than has been offered by one of the associated firms, if a lower outside tender is actually in evidence and it is feared that the order will fall to an outsider. In this case, also, as in regard to every limit, it is considered that the order becomes settled on the acceptance of the limit. The presumption in this connection is that the accepted price does not fall below that to which the offices are allowed independently to go, otherwise a previous inquiry of the parent house is necessary. A limit may be suggested to the interested party when price level protection comes into play, and the acceptance of a limit is to be immediately followed in every case by an understanding with the other protection firms through the intermediary of the parent house.

If a protection agreement for a contract is arranged, the firm which is protected must work out the scheme and forward on request copies of the same to the protecting firms so opportunely that there also remains sufficient time for them to prepare protection offers. In cases in which it is necessary to protect, the completion of the protection offer must be immediately followed by the handing of a copy of it to the protected firm. The handing over of these offers takes place if other arrangements are not made by the parent houses. On the other hand, the protecting firms in the case of protected offers are under the obligation to transmit copies of their offers at once, and the same must be fully examined immediately on arrival, as to whether the protection arranged for has been properly exercised.

The Exercise of Protection.

The protection is to be veiled as far as possible in the interest of the secrecy of the protection agreement. Thus, item for item should perhaps not be protected with the same percentage, but on the contrary, various percentage increases are to be made; indeed, even items of subordinate importance should be raised or lowered. But the final total of the electrical portion must constantly contain the arranged-for minimum protection. If the protecting firms work out other proposals technically, all the proposals which stipulate lower prices, or proposals which imply more work, are to be brought to the knowledge of the protected firm before the submission of the offer, and the firm must declare its understanding with the prices, at the latest two working days after the receipt of the information, or in case of disagreement must properly set forth its objections.

The protecting firms are eventually to offer alternative types which they do not construct, in case this is desirable for the protection of an offer, whereby the protected firm undertakes, in case contrary to expectation, the order should devolve upon a protecting firm, to deliver to the latter firm the types in question at the prices quoted with a minimum rebate of 10 per cent. The foregoing does not refer to steam turbines, the handling of which is to be decided from case to case. The technical offices are under the obligation to take care, with all the means at their disposal, that the orders to be placed in their respective districts should not fall to outside firms. In the first place the office of the protected firm has to attend to the securing of the orders protected for it. In the case of orders which devolve upon outside firms notwithstanding the protection arrangement, the office losing the transaction will have 20 per cent. of the business concerned deducted from the annual turnover.

We now come to the reply made on behalf of one of the syndicated groups. It runs somewhat as follows:—

Reply on Behalf of One of the Syndicated Firms.

The motives which prompted the combination lay in the questions of price wars, underselling owing to inconsiderate estimates, or errors in calculation, undercutting of prime costs in many cases, and the rapidly increasing expenses in connection with the number of projects, for which each firm is approached individually. It is characteristic of the electrical industry that orders are only received for about one-hundredth part of the schemes which are worked out at great expense. The idea of syndication was, consequently, made clear, and the opportunity for settling it was afforded by the regular sittings of the Association of German Electrical Firms. The Association, which exclusively comprises the heavy electrical departments, is known for having effected temporary increases on the list prices, which have, however, fallen in the meantime; also for the unification of the conditions of guarantee in the heavy branches, and likewise for the amelioration of the fire insurance conditions for risks with electrical installations.

The Association at that time—the year 1901—comprised the Allgemeine Co., the Bergmann Co., Brown, Boveri & Co., Essling Machine Works, Felten-Guilleaume & Lahmeyer, Garbe, Lahmeyer and Co., of Aix-la-Chapelle, the Karlsruhe Electrical Industry Co., the Helios Co., Poege, Poschmann, the Sachsen Works, Siemens-Schuckert, Max Schorch, of Rheydt, the Schwartzkopff Co., of Berlin, and the Cologne firm of Geist, which latter subsequently withdrew. A few years after the formation of the association, the suggestion was made among its constituents that endeavours should be made to establish a syndicate, comprising all firms as far as possible, for the improvement of prices. Negotiations on the subject were conducted in full meeting and in special committees for a long time; the draft statutes were repeatedly remodelled, and down to the present time the matter appears on many sides to have not yet been given up for lost, although in view of the variety of the products, the continual changes in the manufacture, the graduation in sizes and the separate course of development of the individual producers, the question was and must remain an extraordinarily stubborn one.

Formation of the Combination.

The endeavours to form a syndicate were again discontinued in 1903 on the ground of there being no prospect of bringing the scheme to a successful issue. The three firms—the Allgemeine Co., Felten and Guilleaume-Lahmeyer and the Siemens-Schuckert Co.—then made an effort with the present so-called secret syndicate, that is to say, the protection agreement. It appears important, the inspired communication proceeds to observe, for a judgment of subsequent events, to bear in mind that accession to this agreement—which was placed in draft form before all members of the Association of German Electricity Firms, and was discussed with them—is to-day still kept open on the condition that those joining also agree to the fixing of a proportionate share in the total sales, such allotment to correspond at the highest to the last year's turnover of the new members. The protection agreement, according to the wish and corresponding to the circumstances of the large firms, only includes transactions of £1,000 and upwards, but the smaller firms pressed for a reduction of this minimum. An understanding was, however, not obtained, and finally all other firms remained outside the agreement. However, the contents of the agreement were known to them, and this, as well as the imperfections of the protection agreement, have materially weakened its effect. The outstanding firms have gained through it an extensive means of propaganda against the three large firms, and it is stated that since the formation of the syndicate, the turnover of the smaller firms has increased in a larger proportion than that of the three members of the syndicate.

The tendency of the agreement, according to the text of various published paragraphs, is a fighting one, and sharply turned against outsiders. On this point the inspired communication remarks that Clause 7, which is largely drawn upon, states almost literally at the beginning:—"No order is to devolve upon an outsider," and the protected firm becomes liable to a penalty if it loses the order under normal circumstances. But this addition shows, in the opinion of the inspiring authority, that the whole regulation should be conceived more as a barrier against negligence of the members than as a word against outsiders. The idea that all orders competed for by the syndicated firms must fall to them, is also dismissed as Utopian and unjust. Moreover, the regulation refers solely to normal protection, which does not yet constitute 1 per cent. of the total turnover, but the penalty consists in an increase on the allotment carried out of 20 per cent. of the value of the order lost. This means, for instance, that the negligent firm, in the case of a lost order of the value of £2,500, has subsequently to submit to a reduction of £500 in the amount of its allotment. A cash fine or direct penalty consequently neither hits the negligent firm nor its representatives.

The Actual Aims of the Syndicate.

The agreement, according to the conception of those interested, aimed at the provision, in the first place, of a guarantee against the mutual and ruinous depression of prices. It was arranged that the three firms should not quote below certain minimum prices, and it was desired to render ineffective the system employed by customers of playing one firm against another. The secret syndicate has for years past really abstained from any aggressive action against outsiders, and it is solely known that measures were taken in 1907 against a firm in Saxony, and in point of fact only when, as is assured, the latter had given occasion thereto by severe underbidding. In general the policy of the syndicate lies in the endeavour to improve prices and not to fight, which, on the contrary, would result in retrogression in prices. On the other hand, the opinion is entertained that the firms cannot be held guilty of overcharging customers or of exploiting the monopoloy. Testimony on this point is afforded by the circumstance that according to the agreement no firm can be compelled to exceed, in the case of a protection offer devolving upon it, the normal list prices which are known both to customers and competitors.

The inspired communication sets forth further that many transactions, such as large municipal contracts and similar works, are completely excluded from the agreement. Even in the case of protected transactions, the purchaser is not unconditionally assigned to the protected firm, that is to say, to the firm submitting the lowest offer. If he desires to entrust the order to one of the two other firms at the price of the protected offer—which the protecting firms often endeavour to bring about—there is nothing to hinder him from so doing. Each of the projecting firms is, in fact, expressly empowered by the agreement to accept and execute such orders entrusted to it, and cases of the kind occur every day in practice.

The foregoing observations refer, as previously mentioned, to contracts relating to dynamos, motors, transformers, switchboards, &c. But a word has to be said in relation to the trade in secondary batteries, in which, as reported in former issues of the Review, an endeavour has been made to establish a monopoly. On this point the *Berliner Tageblatt* quotes the following circular sent out by one firm to its branches:—

The Trade in Secondary Batteries.

We have recently been compelled to receive various communications from absolutely reliable sources of orders which have fallen

to ————, without our having had any reports from you on the matter. In consequence of this we could not employ the means at our disposal for not letting the competitor do the business. We, therefore, see ourselves induced to point out to you your instructions and to urgently beg you much more than hitherto to control all pending transactions, whether the rivalry of the competitor can come into consideration or not, and to constantly keep your representation to the matter. Information is to be given to us without delay of all cases of business in which the competitor in question appears, or could presumably appear, in order that we may occasion further action. You will also give us information, even if you believe yourself certain of the order notwithstanding the competitor, as experience has already largely taught that your information was not correct. We emphasise finally that fighting the firm of ————, whether in prices or eventually by pushing forward an installation firm, or whether it be in relation to quality of the product or the firm, is under no circumstances, and is as little admissible as a combat with the firm of ————.

The information put forward by the foregoing extracts relating to the working of the inland trade in Germany requires no comments on this side of the Channel, as the details speak volumes for themselves.

A GERMAN VIEW OF THE FUTURE OF THE METAL-FILAMENT LAMPS.

Herr H. Remané, of the Deutsche Gasglühlicht A.G. (Auer Gesellschaft), gives an interesting summary in the *E.T.Z.* of the position of the metal-filament lamps as compared with that of their various rivals. He considers that the public are glad to employ lamps of greater power than the old 16-c.p. carbon lamp, provided this can be done without much increase in cost. This is indicated by the large c.p. (60 or more) of the incandescent gas lamps now normally employed, and also by the following table, which shows the percentage of the various candle-power lamps sold by a large dealer. The figures for the carbon lamps refer to a period some years back, and the candle-power of the carbon lamp most in demand has increased somewhat recently, but the distinct tendency of the public to employ larger candle-powers when the cost for candle-power falls is clearly brought out :—

Hefner c.p.	Carbon-filament lamps taking 3·4 watts per Hefner c.p.	Osmium lamps taking 1·5 watts per Hefner c.p.	Osram lamp taking 1 watt per Hefner c.p.
16	60 per cent.	10 per cent.	—
25	20 ,,	55 ,,	20 per cent.
32	15 ,,	35 ,,	50 ,,
50	5 ,,	—	30 ,,

The next table indicates that the candle-power selected by the public is approximately that which involves an expenditure of 2 pf. (nearly one farthing) per hour, whatever the nature of the lamp :—

	Incandescent gas.		Electric light.		Petroleum lamp (20 to 40 Hefner c.p.).
	Hanging.	Standing.	Carbon filament.	Osram.	
Cost of gas, current or oil per spherical Hefner c.p.-hour in pence ...	·0034	·0042	·019	0075	·01
Cost per Hefner c.p.-hour stated as a per cent. of the cost of the hanging gas lamp	100	125	570	220	304
Spherical Hefner c.p.-hours obtainable for 2 pf. (·24 penny) ...	71·4	57·1	12·5	32·4	23·6

In this table the cost of gas has been taken at an average German figure of 4s. 7d. per 1,000 cb. ft., and the cost of electricity at 5½d. per kw.-hour.

The effect of the cost of the lamp on the total cost to the consumer is shown by the following table, on the assumption that the cost of energy is again 5½d. per kw.-hour, that the cost of a carbon lamp is 6d. and that that of an Osram lamp varies from 3s. to 5s., according to size, and that the useful life of a carbon lamp is 500 hours, and that of an Osram lamp, 1,000 hours :—

	Carbon filament. Hefner c.p.				Osram. Hefner c.p.			
	16	25	32	50	25	32	50	100
Watts per lamp ...	50	75	96	150	27·5	35·2	50	100
Cost of current per hour in pence ...	·27	·41	·52	·81	·15	·19	·3	·59
Cost of lamp replacement per hour in pence ...	·012	·012	·012	·012	036	036	·036	·06
Total cost per hour in pence ...	·282	·422	·532	822	·186	·226	·336	·65
Total cost as a % of the cost of the 16-c.p. carbon-filament lamp ...	100	148	188	292	66	80	118	232

This table confirms the fact that the Osram lamp of something like 32 c.p., is likely to take the place of the 16-c.p. carbon lamp, especially when it is remembered that the cost of installing a certain total candle-power is reduced as the candle-power of the units increases.

The next question discussed by Herr Remané, is that of the probable voltage of the future lamp and the future supply station.

The higher voltages introduce well known economies, especially in direct-current systems, but the 200-volt metal-filament lamp is undoubtedly somewhat less efficient than the 110-volt one of the same candle-power, just as is the case with carbon filament lamps. Experience has shown that if the 110-volt lamp works with 1 watt per c.p., the 220-volt metal lamp will require, for the same length of life and constancy of candle-power, about 1¼ watts per candle-power in sizes from 40 to 100 c.p. The writer considers that the utmost that further experience or skill will attain to is a reduction of the 220-volt consumption by only a small percentage, and that the superiority of the 110-volt lamp will always remain. It is hardly probable that a 220-volt 32-c.p. lamp taking less than 1·4 watts per candle-power, or a 25-c.p. lamp taking less than 1·6 watts per candle-power will be obtainable, at least in the near future.

The cost of running a 32-c.p. lamp on 220 volts is, therefore, some 30 per cent. greater than on 110 volts, and the economies introduced by the higher voltage are hardly likely to reduce the cost of current by anything like this percentage.

The added difficulties met with in constructing the 220-volt lamps are due to the thinness of the filaments, which prevents their being safely handled in quantities, causes unavoidable variations in diameter, and leaves them liable to breakage when in use through the electrical forces set up in the lamp. The superiority of carbon filament over tungsten filaments in this respect is shown by the following particulars of the actual dimensions used :—

c.p. and voltage.	Type of filament.	Filament. Diameter mm. (average).	Filament. Length mm. (average).	Watts per Hefner c.p.
50/220	Carbon filament.	·13	400	3
32/220		·12	380	3·5
25/220		085	350	3·5
16/220		·07	275	3·5
10/220		·06	265	4
50/110		·23	240	3
32/110		·18	230	3·1
25/110		·16	220	3·1
16/110		·12	200	3·1
10/110		·075	175	3·5
50/220	Osram filaments.	·0342	—	1·25
40/220		—	1,040	1·25
32/220		·0254	910	1·25
25/220		·0216	826	1·25
16/220		·0154	723	1·1 (calculated)
50/110		·053	605	1·1
32/110		·0395	524	1·1
25/110		·0328	490	1·1
16/110		·0244	410	1·1

It will be seen that it is not possible to construct, for instance, a 50-c.p. 220-volt 1-watt per c.p. lamp, by simply

using double the length of the same filament as is used in a 110-volt 25-C.P. 1-watt per C.P. lamp. The actions which go on in all vacuum lamps when alight, invariably affect the high-voltage small current lamps more than the lower voltage ones, and make it necessary to reduce the temperature of the filament, and consequently the efficiency, in the former, if equal life and constancy of candle-power are to be attained. At the same time the price of manufacture of the 220-volt lamp is bound to be greater than that of the 110-volt one, because of the greater length and delicacy of the filament to be handled.

The experience with carbon filament lamps has shown that no amount of practice has enabled the makers to produce 220-volt lamps of equal quality to 110-volt ones, and in view of this, the writer concludes that it would be well to hesitate before designing new stations for 220 volts, unless it is certain that this voltage would enable the current to be sold at least 20 per cent. cheaper than if 110 volts were adopted.

THE EDUCATION OF ENGINEERS.

THIS subject is continually being discussed by learned bodies, yet, despite the profusion of debate, controversy still rages. Just as no one man can hope to become expert in every branch of engineering, so no one method of instruction is equally applicable to all subjects and cases. The author, therefore, feels justified in asserting a few principles which seem to him essential, not only to the training of engineers (the special subjects of this article), but also to the training of the general scientist. Many of the methods postulated are even penetrating to the curriculum of the ordinary secondary school.

The first point needing consideration is the extent to which oral lectures should be replaced by text-books. With the growing excellence and decreasing price of modern text-books, one is apt to expect them to replace expensive courses at technical colleges—expensive both as regards money and time. In the case of many students, complete day courses at a technical institute are impossible, on account of the direct and indirect expenses (fees and loss of wages respectively). In such cases text-books have to be largely relied on, the field being too great to be covered by evening classes alone.

The writer is, however, of the firm conviction—shared by most of those who have experienced a college course—that there is much that is irreplaceable in oral lectures. The subject matter, robbed of verbosity, can be imparted in short clear sentences; many expressive phrases can be delivered orally, which, if placed in print and removed from the exact conditions which inspired them, would lose their whole value.

The personality of the lecturer, so valuable to the student, cannot be appreciated from his books, and naturally, not from the books of others from which he may draw his matter.

Nevertheless the ability to profitably consult text-books is of great value to the student, and though the art is largely intuitive, it can be acquired to a certain extent. In the early stages of any training, however, during the period in which the student is being taught *how to learn*, personal instruction is essential.

With regard to the study of text-books, the author has found it an excellent plan to continually make notes of the most salient features of the matters dealt with. This not only impresses the facts on the mind, but makes possible a rapid revision of the whole field, besides enabling the inter-relationship of the branches to be followed. Such a method concentrates the attention on the matter during reading, and greatly conduces to a perfect understanding of the subject, for it is not till a paraphrase or summary of a section is attempted that the slight haziness of comprehension is detected, which, if not at once corrected, leads to so much confusion later. The notes so prepared should be quite brief and to the point, and in their preparation instruction received at school in commercial *précis* writing proves very valuable.

Naturally it takes longer to read a book in the first place on this system, but the revision of the summary is quickly effected; the briefest notes form valuable "refreshers," since the student has (or ought to have) only made them on points presenting difficulties to him.

The writer is convinced that the matter of a text-book can be much more effectually and rapidly assimilated by this method than by any other, though the initial reading may take longer time than otherwise necessary.

So many text-books are available that great care should be exercised in their choice, and it is in this respect that the experience of a professor is so valuable. All groups of students should be referred to technical literature appropriate to their needs. Many professors have a great weakness for mathematical proofs, and will always recommend a book based on these methods in preference to any other. It is absolutely essential that a student should gain clear ideas in the first stages of his training, or trouble will inevitably follow therefrom in the later stages of study; in the earlier steps *no* detail should be left in the least uncertain. This being so, the author would here most earnestly urge all writers to endeavour to make their treatise as clear as possible, this frequently being chiefly aided by a minimum use of mathematics. A worded explanation is, by the very nature of our every day intercourse, far more acceptable to the majority of students than a mathematical dissertation, even if the latter occupy less space on a printed page. The impression that advanced mathematics consists of a skilful jugglery of symbols dies hard.

Many writers will assert with superiority that their subjects are "above" ordinary students and so forth; that may be so, but even then nothing but good can result from as simple an exposition as possible.

It is mainly owing to the lack of sympathetic connection between manufacturers and laboratory experimenters that manufacturing technical progress is losing ground in England. One has only to read the papers now delivered before "learned" societies to realise the rather ludicrous and wholly harmful degree to which complicated proofs and word-obscured facts are being pushed. The whole object is, apparently, to prevent anyone but a few members of the said learned body, understanding anything about the matter. Such a tendency is exactly opposed to increase of efficiency in education.

The average engineering student finds the proceedings of the engineering bodies in his particular branch of the science largely unintelligible, whereas there is really much valuable material, which he could readily assimilate were it expressed in a simpler form. An unfortunate impression seems to be arising among technical authors that, for the dignity of their profession, everything published must be exceedingly abstruse.

In this connection, the value of papers and articles written by students themselves cannot be over-estimated. Knowing the difficulties which they experience, they can, by mastering these, present to their fellow-students most appropriate and valuable theses. For this reason, any technical magazine issued by the students and technical papers read before their Engineering Society, should be encouraged. They fulfil a most valuable function, and remove difficulties of which the tutors are hardly cognisant (for it is common experience that, having once disposed of difficulties, it is extremely troublesome to place ourselves in the old position in order to analyse how the difficulty arose).

At one time only articles from contributors with long experience behind them would be accepted by technical magazines. Now, however, younger contributors have every opportunity of explaining their views and of making suggestions for the removal of their difficulties. A series of articles by authors ranging from the freshly graduated student to the retired veteran of the industry presents the best solution possible to the question of the thorough education of engineers.

Many present-day lecturers neglect the fact that modern engineering practice is so young that they have lived through, and watched, the major part of its changes, and have seen how advance has logically followed advance, whereas their students, having had no such advantage, experience con-

siderable difficulty in tracing the developments of the science. For this reason, instructors should set forth the various stages of progress and their inter-relations very clearly.

The power of reasoning must be developed most carefully, and the first year of a college course is well spent in cultivating a thorough groundwork of method and reasoning power. Without doubt, this preliminary training should be carried out in our schools, but until it is done there, and on a thoroughly reliable basis, there is grave danger in omitting the usual "first year course." This preliminary instruction is frequently voted a bore by students undergoing it, but in few cases is it regretted in the later years of the training, when a vast amount of new work has to be done, and where the methods of the first year have a valuable application.

So vast is the field of present-day engineering that the student cannot hope to learn even a small percentage of the knowledge available, and certainly not during the usual three-year course. In this course (which might well be extended, though there are great objections to too long an academical career) the student should be led well into every field of the industry and thoroughly grounded in the principles and methods used. Later, when he comes to specialise and to pursue private study, he will be able to utilise the vast stores of information now accumulated on every subject.

A college course can do nothing more and could do nothing better than teach its students the fundamentals of engineering, and the method and logic necessary to continue the study—the way to reason and to apply old facts to new purposes—the way to create—the way to meet all emergencies. Individuality should be cultivated as much as possible in students, new methods and ideas should receive due reward, and, above all, a rigid, stereotyped method of performing a given piece of work, a report or calculation, should be absolutely avoided. The lecturer should indicate the methods available and advisable, but every encouragement should be given to students to use the "tools" delivered to them, in lectures and by nature, in novel ways. Self-reliance and individuality are essential to an engineer.

Care must be taken, in rewarding enterprise, not to penalise the hard-working but non-inventive student with regard to his more brilliant and original colleagues. The standard should be set by reference to the average ability of the class; if regulated by the head scholars alone, very many hard-working men would fail to obtain a pass percentage. The subject of equitable marking needs much discrimination.

The particulars in which improvements are required, and the general means by which they are being sought, must always be indicated, for such knowledge is only attained to, otherwise, by long experience; it is the duty of the tutor, having had this, to enable his students to benefit by it.

In the further development of system and original thought, research work in the laboratories is extremely valuable, and here again a college course is irreplaceable. Of late years, however, there has been a tendency to rather nullify the benefits of research by placing students on to elaborate investigations before they are fully practised in the tests and methods necessary to their prosecution. The student must be thoroughly conversant with the standard uses of his "tools" before he is set to use them in original applications.

The fundamental principles of research must be firmly instilled, viz.:—

1. The definite statement of the reason or motive for doing any piece of work. A full statement of the conditions and circumstances leading up to its inception.

2. Accurate details, *recorded at the time of observation*, to be tabulated, of the progress of events during the experiment or test.

3. Full and logically arranged deductions must be drawn from the results obtained, sufficient grounds being required for every statement made.

With regard to the delivery of lectures and notetaking, these matters entirely depend on the personalities of lecturer and students, and on the subject.

The author is strongly in favour of rough notes being taken by the students during the lectures—these notes forming a skeleton *prêcis* from which a full account of the lecture matter should be written as soon as possible. Certainly no other system so thoroughly impresses the facts on the mind.

A few points which lecturers might well bear in mind are:—(*a*) The speed of delivery of the lecture should be very moderate, or repetition and resultant net loss of time and clearness will result. The speed should show no sign of hesitation or lack of familiarity with the subject. (*b*) At the commencement of a course, the students should be informed of its precise object and scope. (*c*) As the course proceeds, the practical application of every theoretical result must be continually pointed out. It must never be forgotten that the object of an engineer is "to apply the forces of Nature to the uses of man;" (*d*) When introducing a fresh subject or discovery, as many diverse applications as possible should be mentioned in the first place—these applications not necessarily following in logical order on each other—the object being to arouse the interest of every section of the audience.

Then, as the lecture proceeds, the various steps and applications must be kept in strictly logical sequence so as to enable all to fully appreciate the lines of development.

The maintenance of discipline is, of course, essential, and though more vital, perhaps, than in ordinary schools, it is more readily maintained. In the first place, the students themselves have usually the sense to see the fundamental importance to their future of a thorough utilisation of their college opportunities. This is more particularly so in a technical college than at Oxford or Cambridge, where the "social" life is such a salient feature. In any case, the strictest means must be employed to keep absolute order; in most institutes a single reprimand, with or without suspension, is usually followed by immediate expulsion on repetition of the offence. It is clearly demonstrated to "slackers" that it is neither to their benefit nor to that of the college that they should continue their attendance.

During the first few months of a course, however, allowance must be made for the irrepressible wildness accompanying the first freedom from school. In enforcing discipline, too, it must be remembered that, while some of the students came straight from school others have had works' experience varying from one to five years in duration.

The latter class will, in many instances, be persuaded with great difficulty of the real value of theory, yet in spite of their "experience," one will find weird efforts in their various machine designs. The "practical" man is usually characterised by a very cheery optimism in himself, but an all-pervading pessimism as regards the merits of calculation and design based on precedent.

The question as to whether a "practical" training (*i.e.*, period in a manufacturing works) should precede or follow a college course has been much discussed. The factors involved are too many to be fully discussed here, but the general concensus of opinion is that college should precede "practice," the student going straight from school to college, meanwhile obtaining short periods of works' experience in the vacations if possible.

This system has the advantage that the scholar passes from school to college without losing the knack of studying, and without being unsettled by a period of "freedom." Such a student can, later, rapidly apply his theory to practice, one year being quite sufficient for the metamorphosis as a rule. On the other hand, a man takes badly to study after five years' absence as apprentice, and, moreover, finds himself unable to acquire knowledge with the same facility as when he was at school: he has the advantage of at once seeing the practical application of theoretical matters discussed in lectures, but, on the other hand, he misses much of the value of his practical training by his ignorance of the theory pertaining to it.

The time at an engineering college is all too short, in view of the vast field to be covered, to attempt any "general" education as well, but the value of a sound general ground work, laid at school and continued in after-life, cannot be over-estimated. The value lies largely in the broadening influences of such an education; any factor tending to improve the reasoning powers is of great value in the training of an engineer. Specialisation is a dangerous creed, and, in the early stages of a training, is fatal. A broad view of all branches of science is essential, so that the interlinking of facts and laws may be thoroughly grasped.

Subjects should not be "pigeon-holed" and kept severely separate. It is because of this tendency that many discoveries and inventions have been made by men only slightly acquainted with the subject of their improvements (in the first place at any rate).

Experts in one department, in the narrowness of their specialisation, frequently overlook the application of the laws and methods of another branch to their own.

This learning to inter-connect branches of the tuition is another function of the college training. The relations between the various subjects should be pointed out from every possible aspect, and the departments (of mathematics, physics, &c.) can often be arranged so as to reach corresponding points at about the same time. This coincidence, suitably emphasised, greatly impresses the relations between the sciences.

Many formulæ and results are used in quite a number of different branches of science, and hence are frequently proved separately in each department. When this is the case, the best and most lucid proof should be decided upon and adopted as the standard by all the lecturers (alternative proofs being set as exercises and explained to those students particularly interested, or to those who do not fully understand the standard proof). The principle, so often adopted, of every department forcing a separate and distinct proof of a certain matter on to the student becomes very confusing, and unless the student has the initiative to isolate one for himself, relegating the others to his note-books for reference only, he is apt finally to remember none of the many alternatives.

In practice one attempts to remember none but the most fundamental formulæ and equations; all others should be carried in a reference note-book. Many formulæ are far too complex to be safely memorised in practice.

It is an evil of the examination system now current that during his three years' course the student has to remember many data which even his professors admit will be immediately and profitably forgotten when he leaves college.

The point is, in commercial work, not to remember formulæ, &c., by rote, but to know just where to refer to the data required.

In connection with the possibility of expressing one fact in a number of ways, it is in this respect that the advantage of oral teaching over text-books is apparent. A good lecturer can at once express his statements otherwise if the first exposition be not quite clear to all listeners. Such paraphrasing should not be employed too freely, or confusion will result. Also, when rediscussing the same matter from a different point of view, it is essential to state expressly that this is being done, or confusion will again result, owing to an impression in many minds that an entirely new subject is being treated.

Analogies to matters of common knowledge are very valuable in able hands, but, as in the case of water analogies to the electric current, care is needed not to misrepresent the feature of the analogy.

Owing to the increasing complexity of designs of machinery and tests on the same, the value of tabular statements and "pedigree" charts showing sequence of design, &c., is continually increasing, while the value of curves or "graphs" is, of course, inestimable. Any device (such as sector diagrams, polar curves, &c.), which shows at a glance the quantitative results of a long series of tests, is to be explained and full practice in its use afforded. A curve plotted from a set of data will give information which could never be obtained by inspection of the table of figures alone; moreover, this information is given instantaneously.

Suitable illustrations and slides greatly aid the lecturer both as regards time and clearness; demonstration experiments serve to enforce the points referred to, but should in no way replace the laboratory work of the students. A continuous laboratory "log" should be kept by each student, in which he enters results and deductions as they occur. This book should be examined at very frequent intervals: if it be made compulsory to register, at least roughly, the full results of an experiment, the student is possessed of a logical account of the developments of the test, and the troubles arising from tricks of memory with regard to chronological sequence of measurements cannot arise.

Some lecturers err by making their lectures too "popular," much of their value being so lost. The average student is, unfortunately, apt to look with scorn on any matter placed before him in a "popular" light.

There being such a vast amount of technical literature now published weekly, it becomes impossible for the student to do his college work, and keep, at the same time, cognisant of all the latest developments. On this account it is an excellent plan, and one much appreciated, for the lecturer to make weekly references to the more important sections of the current papers and proceedings. A summary of the lines of development and current objects of research in foreign countries, should also be presented from time to time.

It is impossible, in most cases, to give a complete course of lectures on the commercial and legal branches of engineering, but it is essential to at least indicate the rudiments of technical book-keeping, particularly as applied to the collection of data for future use in estimating, and of the procedure necessary to the obtaining of legal powers to execute new schemes. Patent law is of great importance to any engineer engaged in an industrial manufacturing concern, but this must, as a rule, be studied after the completion of the normal college course.

The author fears that the above has departed rather from its original purpose—a treatise on the "General Principles of Education of Engineers"—into a heterogeneous mass of details. However, as it is the sum effect of the smallest details which now decides the effectiveness of a scheme of education, it is hoped that some good will result from this collection of material.—WREN.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

21,532. "Improved detachable commutator." J. W. LEE and E. TEE. October 12th.

21,537. "Improvements in insulating boxes for electric cells and other purposes." J. T. SZEK. October 12th.

21,568. "Improved device for fixing carbon brush holders." Firm of ROBERT BOSCH. (Date applied for under Sec. 91 of the Act, September 28th, 1908, being date of application in Germany.) October 12th. (Complete.)

21,576. "Improvement in electricity meters." H. ARON. October 12th. (Complete.)

21,577. "Constant water-cooled X-ray tube." F. P. RITTERSHAUS and G. BANTZE. October 12th.

21,578. "Improvements in relays for telephones and the like." E. C. R. MARKS. (L. W. Southgate, United States.) October 12th.

21,580. "Improvements in and relating to the control of dynamo-electric power systems." AKT.-GES. BROWN, BOVERI & CIE. (Date applied for under Sec. 91 of the Act, October 14th, 1907, being date of application in Germany.) October 12th. (Complete.)

21,586. "Improvements in measuring instruments for alternating currents according to the Paalsow-Rubens bolometric principle." H. LUX. (Date applied for under Sec. 91 of the Act, October 10th, 1907, being date of application in Germany.) October 12th. (Complete.)

21,596. "Improvements in signal systems for railways and the like." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) October 12th. (Complete.)

21,602. "Improvements in electric light stand." J. F. PIERCE. October 12th. (Complete.)

21,603. "Improvements in and relating to devices for protecting transformers, cables, and other electrical apparatus." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Sec. 91 of the Act, April 29th, 1907, being date of application in Germany. An invention comprised in Application No. 9,237, dated April 28th, 1908.) October 12th. (Complete.)

21,628. "Improvements in or relating to electric traction on the surface-contact system." THE S.P. (SUCHOSTAWER PATENTS) SYNDICATE, LTD., and H. M. SAYERS. October 13th. (Complete.)

21,640. "Improvements in and relating to covers for electrical switches and other articles." W. R. COMINGS. October 13th.

21,659. "Improved electrical signalling system." N. JACOBSENS ELECTRISKE VAERKSTED. (Date applied for under Sec. 91 of the Act, October 14th, 1907, being date of application in Norway.) October 13th. (Complete.)

21,667. "Suspending and protecting device for incandescence bodies with extensible sleeve ring." A. MARTINI. (Date applied for under Sec. 91 of the Act, October 16th, 1907, being date of application in Germany.) October 13th. (Complete.)

21,670. "Improved method of mounting electric incandescent lamps." H. GIRARD. October 13th.

21,674. "Improved switch for controlling electrical circuits." T. J. RORKE and E. RORKE. (Date applied for under Rule 13, January 3rd, 1908. An invention comprised in application No. 12,967, dated June 4th, 1907.) October 13th. (Complete.)

21,675. "Improved automatic electrical cut-in and cut-out switch." C. STIRLING. October 13th.

21,687. "Apparatus for the electro-deposition of metals." T. A. SMITH and T. DEAKIN. October 14th.

21,694. "Improvements in the poles used on overhead electric cars for transmitting the current." E. BROWN. October 14th.

21,737. "Improved method of securing electrical continuity in electric conduits." F. RAWLINGS. October 14th.

21,740. "Improvements in electrical commutators." E. G. CLEVERLY and F. L. ANDERSON. October 14th.

21,741. "Improvements in or relating to electric furnaces." C. A. KELLER. October 14th. (Complete.)

21,743. "Furnace electrically heated by means of small pieces of high-resistance material for melting and boiling and in particular for determination o melting and boiling points." A. DECKERT. October 14th.

21,756. "Improvements in electrical resistances." G. Cooper. (F. Boelling, Germany.) October 14th.

21,760. "Improvements in and connected with incandescent electric lamps." C. Polden. October 14th.

21,761. "Device for cooling the commutators of electrical machines" Allgemeine Elektricitats Gesellschaft. (Date applied for under Sec. 91 of the Act, October 15th, 1907, being date of application in Germany.) October 14th. (Complete.)

21,765. "Improvements in and relating to fluid pressure governors especially applicable in connection with electrically-driven air compressors." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 14th.

21,779. "Improvements in apparatus for limiting the supply of electrical energy." G. Wilkinson. October 15th.

21,802. "Improvements in galvanic cells." J. T. Szek. October 15th.

21,813. "Improvements in and relating to electric current generators." W. A. Trier. October 15th.

21,823. "Improvements in storage battery electrodes." The Chloride Electrical Storage Co., Ltd., and B. Heap. October 15th.

21,834. "Improvements in mercury and other vapour electric lamps." H. A. Kent, H. G. Lacell and The Silica Syndicate, Ltd. October 15th.

21,835. "Improvements in suspension devices especially applicable for arc lamps and the like." J. Neu. October 15th. (Complete.)

21,912. "Improvements in electrical fittings." Siemens Bros. & Co., Ltd., and J. Snow. October 16th.

21,918. "Improvements in or relating to electrical potential regulators or speed-controlling devices." Siemens Bros. Dynamo Works Co., Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) (Application for Patent of Addition to No. 14,725, 1907.) October 16th. (Complete.)

21,915. "Improvements in and relating to switches." H. M. Rice, J. M. Cash, J. S. Brooker and C. B. Rice. October 16th. (Complete.)

21,918. "Improvements in electric conductors." C. J. Beaver and E. A. Claremont. October 16th.

21,925. "Improvements in automatic accumulator switches." R. J. P. Briggs. October 16th.

21,935. "Improvements in direct-current dynamo-electric machinery." A. H. Midgley and C. A. Vandervell. October 16th.

21,936. "Improvements in direct-current dynamo-electric machinery." A. H. Midgley and C. A. Vandervell. October 16th.

21,937. "Improvements in direct-current dynamo-electric machinery." A. H. Midgley and C. A. Vandervell. October 16th.

21,938. "Improvements in direct-current dynamo-electric machinery." A. H. Midgley and C. A. Vandervell. October 16th.

21,955. "Improvements in and connected with electric transformer switches." J. P. Annacker. October 16th.

21,960. "Improvements in and relating to protective devices for electric distribution systems of the type known as lightning arresters." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 16th.

21,988. "Improvements in controllers for use in connection with electrically-propelled tramcars and like vehicles." C. H. Spencer. October 17th.

22,008. "New or improved anti-vibration device for electric light pendants and the like." A. Newall. October 17th.

22,014. "Improved process for the manufacture of galvanic metal reproductions of articles of the plastic arts." C. Bensinger. October 17th. (Complete.)

22,028. "Improvements relating to the control of electric generators." M. I. Williams-Ellis. October 17th.

PUBLISHED SPECIFICATIONS.

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Alternating-Current Electric Motors. H. C. E. Jacoby. 22,527. October 12th.

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Arc Lamps. D. Timar and K. von Dreger. 24,027. October 30th. (Date applied for under International Convention, September 7th, 1907.)

Means for Operating from a Distance Electrical or Fluid-Pressure Driven Organ-Blowing Apparatus. J. Page. 24,260. November 2nd.

Electrolytic Condensers. British Thomson-Houston Co. (General Electric Co., United States.) 27,424. December 9th.

Loose Handle Single-Pole Electric Circuit Breakers. S. Whipp, F. Whipp and C. Bourne. 28,003. December 19th.

Storage Battery Plates. A. O. Tate. 28,106. December 20th.

Electric Circuit Breakers. W. H. Scott. 28,199. December 21st.

1908.

Incandescence Electric Lamps. C. H. Stearn and C. F. Topham. 461. January 8th.

Process for the Precipitation of Electrolytic Copper and other Metals in the Form of Sheets or Cylinders with Soluble Iron or other Metal Anodes. M. J. L. Wenger. 3,504. February 15th. (Date applied for under International Convention, September 9th, 1907.)

Electrical Igniting Apparatus for Internal-Combustion Engines. J. W. Mackenzie. (H. Ford, United States.) 4,517. February 29th.

Connection for Closing an Optional Branch of a Frequently Branched Circuit by means of a Limited Number of Switches. H. Drewell. 7,009. March 30th.

Electricity Integrating Meters. R. Kennedy. 9,254. April 29th. (Post-dated June 10th, 1908.)

Switching Apparatus for Controlling Electrical Machinery. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges., Germany.) 9,540. May 4th.

Regulatable Inductive Resistance. C. Meyer. 9,888. May 6th.

Electric Radiator for Heating Buildings or the like. C. G. Nobbs, C. G. Nobbs, jun., and J. E. Rosenthal. 12,352. June 6th.

Transmitting Apparatus for Submarine Signalling. J. Schiessler. 14,775. July 11th (Date applied for under Rule 13, January 21st, 1908.)

Systems of Operation for Alternating-Current Motors and Generators. W. Cooper. 18,391. September 1st. (Date applied for under International Convention, September 3rd, 1907.)

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If we were to attempt to name one by one all the multifarious contents of the volumes we might have to run still another special issue, and even then a mere catalogue enumeration would be less interesting reading than a chapter of a three-volume fiction, so we will spare ourselves and the reader, too, partly in the belief that the electrical trade knows so well already the classes of goods that are made at the Aston Works, that for them to be told again is quite superfluous. It, then, may perhaps suffice if we congratulate Messrs. Verity upon the departure that they have made from well-beaten catalogue paths, and express a hope that engineers and the trade generally will give them the due reward for their initiative and enterprise. A general index to Vols. I and II appears in each of them, and it is full and at the same time simple for easy reference. 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When we take up Vol. III we find less of the general information, and are at once ushered into the presence of a variety of electric light fittings, some of which, after a more or less close connection with fittings of these classes for many years, make our heart leap and our tongue silent. We have not made an individual examination for discovering the newness and originality of the designs, but, as might be expected, some of them are extremely pleasing, though here and there they may have had to be rather more closely packed in the pages than one might wish. Manifold brackets, electroliers, ceiling fittings, candle fittings, standards, bronze statuettes, cast-iron fittings, illuminated signs, street lighting fittings, shades and fittings parts, these are all followed up by a number of neat designs of lamp and non-luminous type radiators. We think by the aid of the foregoing comments our readers will be able to obtain a fair idea of the character and contents of this three-volume novelty and its usefulness to engineers and buyers in all parts of the world.

Some of the manufactures of Messrs. Veritys, Ltd., are to be found at the Manchester Electrical Exhibition, at the stand of Messrs. J. Lomax Kendal & Co., Ltd. (No. 100), who have been responsible for the electric wiring and fittings work in the Exhibition buildings, and whose exhibit generally is referred to on another page. An electric runway pulley block, manufactured by Messrs. Veritys, is also being exhibited by Mr. H. Luke and the Coburn Patent Track Co.